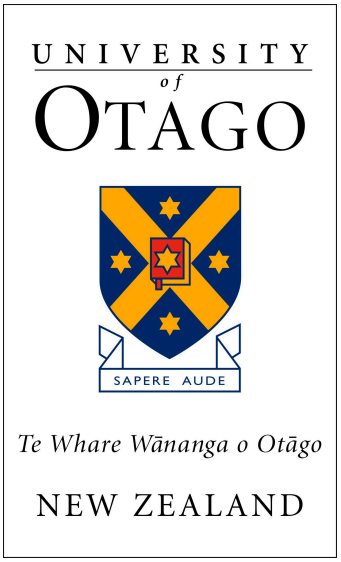

Dental trauma in New Zealand adults: a secondary analysis of national survey and ACC data

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Abstract

Background

Dental trauma is described by the World Health Organization as a worldwide major public health problem. However, little is known in New Zealand (NZ) and worldwide about the dental trauma experience of adults. Most studies of dental trauma prevalence, incidence and aetiology in NZ and overseas have been carried out using convenience samples, such as people attending a hospital dental clinic. The literature shows that a considerable amount of trauma to permanent teeth occurs at a young age. Since most damage to permanent teeth is not self-healing, injuries to permanent teeth and sequelae of the trauma can be carried into adulthood. Dental trauma is therefore a life-long burden for the individual adult and society. While there have been three National Oral Health Surveys in NZ, the 2009 survey was the first to collect information about dental trauma in the interview and examination. In NZ, visits to a dentist for dental trauma and subsequent treatment is recorded with the Accident Compensation Corporation (ACC), a compulsory social insurance scheme. To date, dental injury data recorded with the ACC have not been analysed with respect to outcomes.

Purpose

The objective of this study was to assess the prevalence, risk associations and impact of dental trauma of New Zealanders over 18 years old.

Methods

Information about dental trauma in a representative sample of NZ adults was collected as part of the 2009 NZOHS. This included self-reported information and a clinical examination of the six maxillary anterior teeth. Data were weighted and analysed using Stata.

Data from a separate sample of NZ adults who had sustained dental trauma in 2008 and had the injury registered with the ACC were analysed using SPSS.

Results

Analysis of the 2009 NZOHS data showed that of the approximately 40% who reported previous orofacial trauma, 70% (that is, 28% overall) reported that this included a dental injury. More males than females had experienced orofacial trauma (51% and 31% respectively; $P<0.05$) but there was no sex difference in self-reported dental trauma. The most common injury was a "chipped or broken tooth" (67%). Almost three-quarters had sought treatment for their dental injury. Clinical examination revealed an overall trauma prevalence of 23%, with more males than females affected (27% and 20% respectively). Almost 15% had one injured tooth; 7% had two injured teeth and 2% had three or more. The central incisors were the most frequently affected. The most common clinical dental trauma observation was evidence of "treatment" or an "untreated enamel fracture", more common among males and those aged 35-44.

Analysis of dental information from the ACC revealed that 32,110 adults and children sought treatment for orofacial trauma during 2008. Dental injuries to permanent teeth most commonly involved the central and lateral maxillary incisors. Some 1,325 adults who sustained dental trauma during June 2008 were followed for the subsequent 5 years. Generally, more severe injuries required more treatment.

Conclusion

Prevalence estimates for and characteristics of dental trauma in NZ adults are similar to international findings. There were socio-demographic disparities in the occurrence and treatment of dental trauma in the NZ adult population. The findings confirmed that traumatic dental injuries in the New Zealand adult population constitute an important public health issue, given that many will need life-long follow-up and treatment.

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List of Abbreviations

ACC	Accident Compensation Corporation
ACC42	Accident Compensation corporation Orofacial injury claim form
HS	Health Survey
NHANES	National Health and Nutrition Examination Survey
NZ	New Zealand
NZDep2006	New Zealand Index of Deprivation 2006
NZDepQuin	New Zealand Index of Deprivation 2006 Quintile 1 to 5
NZHS	New Zealand Health Survey
NZOHS	New Zealand Oral Health Survey
MOH	Ministry of Health
OHS	Oral Health Survey
WHO	World Health Organization
WINZ	Work and Income New Zealand
WMT	Prof. Murray Thomson

1 Introduction

1.1 Background

Injuries to permanent teeth affect an individual for life. Dental trauma can range from a simple chip of the enamel to a severely fractured and displaced tooth, or even the complete loss or avulsion of the tooth. Injuries can affect aesthetics and function. Damage to teeth can be immediately disfiguring, or aesthetic problems can manifest subsequently, such as a tooth becoming discoloured or a restoration becoming defective. Pathology may be immediately discernible, or it may occur due to later complications of the trauma. Therefore, most dental injuries need regular follow-up appointments to monitor and treat the injured tooth for many years, and often for the individual's lifetime. Trauma sufficient to result in the immediate or subsequent extraction of a tooth will also result in a lifetime of treatment, through replacement for aesthetic or functional reasons. Patients who have experienced dental trauma are faced with often-significant associated financial and time expense. In New Zealand, the Government absorbs most of the financial cost.

The NZ Government collects information from patients seeking treatment for dental trauma, by way of dental trauma-registered visits to a dentist. In NZ, traumatic injuries to teeth are covered under the Accident Compensation Corporation (ACC). Everyone is included under this compulsory social insurance scheme. However, it is hypothesised that a significant proportion of the population do not seek treatment for traumatic injuries to teeth, and so data from the ACC will not reveal the true population burden of dental trauma. A visit to a dentist for dental trauma may be unmanageable for some people due to cost (most treatment incurs a co-payment), and also time constraints, lack of knowledge and understanding, or the individual placing a low priority on dental health care.

Three large population-based studies on oral health have collected information on the NZ adult population. However, the most recent survey carried out in 2009 was the first to collect information on dental trauma, by way of a face-to-face interview and a clinical examination.

1.2 Thesis outline

This thesis will begin with a review of the pertinent literature, followed by the methodology for this study. Second, the prevalence and characteristics of dental trauma in NZ adults will be described using data from the latest NZO Oral Health Survey (NZOHS). These data are important for the provision of dental services for the NZ population, policy-making and funding. They also describe the overall burden of dental trauma to the individual and society. Third, there will be an assessment of the association between dental trauma—both self-reported and clinical—and putative risk indicators of adults. This information will provide a direction for funding and preventive measures. It is generally acknowledged that males have a higher rate of dental trauma through childhood and adolescence; however, little is known about risk indicators in adults. Fourth, the incidence and outcome of dental trauma registered with the ACC will be examined. A sample of initial trauma claims made with the ACC will be analysed, including a follow-up on a subsample looking at treatment done in the five years after the trauma. The thesis will conclude with a discussion of the findings.

To my knowledge, this is the first study using a nationally representative population, and it will provide new information on dental trauma. It is also the first to analyse dental trauma information from the ACC to investigate both incidence and outcomes in terms of the severity of the injury.

1.3 Aims of the study

The main objective of this study is to assess the prevalence, risk associations and impact of dental trauma in NZ adults 18 years and older (which to date has not been explored at a population level). This will provide new information for NZ

oral health bodies, and augment existing data on the epidemiology of dental trauma.

The findings will provide the dental profession and policy-makers with new information that will be invaluable for prevention, resource allocation and determining the personal and societal burden.

1.4 Hypotheses

It is anticipated that a significant proportion of the adult population has suffered from dental trauma. If this is similar to international population-based studies, it may be as high as almost one-third of the adult population. It is hypothesised that a substantial proportion of NZ adults have untreated trauma, despite being eligible for assistance from the ACC towards dental costs. It is suspected there are sociodemographic disparities in the occurrence and treatment of dental trauma in the NZ adult population.

1.5 Research questions

The research questions to be answered in this thesis are: (1) what are the prevalence characteristics of dental trauma in the NZ adult population; (2) what are the risk indicators; and (3) what treatment is carried out for dental trauma?

2 Literature review

2.1 Introduction

Dental trauma is described by the World Health Organization (WHO) as a worldwide major public health problem (Peterson 2003). Current knowledge of dental trauma in adults is based predominantly on convenience samples. Little is known in New Zealand (NZ) about the dental trauma in adults at a population level.

As literature concerning adult dental trauma is limited, many of the studies examined in this review relate to trauma of permanent teeth in children. These studies are also relevant to this review because the non-healing nature of many dental injuries means the injury—although often occurring at a young age[1]—and the treatment burden is carried into adulthood and can affect people for life. In addition to this, further dental injuries can occur as an adult.

Dental trauma represents an acute transmission of energy to the tooth and the tissues supporting it, such as the gingiva, periodontal ligament and alveolar bone. This results in fracture and/or displacement of the tooth, and /or separation or crushing of the supporting tissues (Andreasen et al. 2007). A traumatic dental injury is considered to be a result of trauma to the mouth, but does not include chipping of teeth due to normal function or fracture of a tooth weakened by caries. In young children, trauma can damage both the primary tooth and the unerupted developing permanent tooth at the same time.

This review of the literature provides an overview of adult dental trauma. The prevalence and characteristics of dental trauma in adults are discussed, followed by a review of the putative risk factors, causes and outcomes of dental trauma. The 2009 New Zealand Oral Health Survey (2009 NZOHS) and the NZ social

[1] The permanent dentition starts erupting around the age of six (Proffit and Fields 2000)

insurance scheme for accidental injury, the Accident Compensation Corporation (ACC), are introduced.

2.2 Epidemiology of dental trauma

Epidemiology is the study of the occurrence, distribution and determinants of health-related events in specific populations (Porta 2008). The information gained from epidemiological studies is used to help control health problems by aiding the development of interventions, public health recommendations and distribution of resources (Porta 2008).

2.3 Study design

The majority of studies of dental trauma are retrospective, based on information from clinical records for injuries that have already occurred, often from institutions such as university or hospital dental departments. Although such retrospective studies contain valuable information concerning different types of dental injuries, treatment and outcomes, they are limited in their generalisability to the whole population, because they are not based on a representative sample and include only people who seek treatment.

A cross-sectional study is a descriptive study that collects information from a population at a specific point in time. It can also be described as retrospective, as the event (dental trauma) has already occurred. A cross-sectional study can be used to estimate the prevalence of a condition, such as dental trauma. The sample is usually large and representative of a population. There are very few cross-sectional studies of adult dental trauma internationally. Cross-sectional studies on adult dental trauma examined in this thesis are from Canada (Locker 2007), Ireland (Holland et al. 1994) and the USA (Kaste et al. 1996; Shulman and Peterson 2004). The cross-sectional self-report study by Locker (2007) was limited to adults from 18 to 50 years of age, while that by Kaste et al. (1996) included permanent teeth in people from age 6 to 50 years in Phase One of the Third National Health and Nutrition Examination Survey (NHANES III). Shulman and Peterson (2004) reported findings from Phase Three of the NHANES III

which included the full six years of data collection, but mainly focused on the relationship between trauma and occlusal characteristics. Holland et al. (1994) examined dental trauma in adults aged 16-34 years as part of a larger nation-wide study. Disadvantages of a cross-sectional study design investigating dental trauma include recall bias and under-reporting of previous trauma such as concussion, subluxations, luxations and root fractures, which are often lacking in signs or symptoms at examination (Feliciano and de Franca Caldas 2006). Radiographs are not routinely used in population-based cross-sectional studies (Feliciano and de Franca Caldas 2006).

Prospective studies determine the incidence, and record new events of a condition (such as dental trauma) for a population within a specified time period. A prospective study is also described as a cohort or a longitudinal study. There are relatively few prospective studies in the literature on dental trauma due to the costly nature of such research.

2.4 Dental trauma studies in New Zealand

Studies investigating dental trauma in NZ to date have been limited to retrospective analyses of clinical records. Most clinical records of dental trauma since 1974 are presented in the format of the ACC dental injury claim form (Appendix I). The first cross-sectional study collecting information on dental trauma in NZ adults was part of a larger survey, the 2009 NZOHS, and will be analysed in this thesis. While some broad findings have been reported, there has not been an in-depth analysis of the adult trauma component.

2.4.1 New Zealand Oral Health Survey (NZOHS)

The NZOHS was a nation-wide cross-sectional study that collected data about oral health and utilisation of oral health services from a representative sample of New Zealanders. There have been two previous national oral health surveys that took place in 1976 and 1988; however, the 2009 NZOHS was the first to collect data on dental trauma. This latest survey was commissioned by the Ministry of Health (MOH) and was a collaborative project between the MOH, Defence Dental

of the New Zealand Armed Forces, the New Zealand Dental Association, and the ACC. Data on the oral health status, beliefs, attitudes, knowledge and practices of children and adults were collected via a face-to-face interview and a clinical examination. The overall objectives of the 2009 NZOHS were as listed in Table 1.

Table 1. Objectives of the 2009 New Zealand Oral Health Survey

Objectives of the 2009 NZOHS
Describe the oral health of New Zealand children and adults, and the prevalence and severity of selected oral conditions, including dental injury;
Estimate the prevalence of risk and protective factors associated with these oral health conditions;
Examine the relationship between general health and oral health;
Examine the relationship between adult oral health and child oral health within households;
Describe the use of oral health services, including the nature of barriers to accessing oral health services, and the extent of any unmet need;
Examine inequalities between population subgroups (as defined by age, gender, ethnicity, rurality and socio-economic position);
Examine changes which have occurred in the oral health of New Zealanders, since previous national surveys; and
Provide policy makers with information that can be used to improve oral health and the oral healthcare system

Data collected in the national oral health surveys are unique because the same information is not available from other means (such as analysis of health records), and so the 2009 NZOHS is considered to the best source of information on the current oral health status of New Zealanders. In addition to those data, self-reported information on oral health (but not oral trauma) has also been collected in the 2002/03 and 2006/07 New Zealand Health Surveys (NZHS). The

2009 NZOHS was a follow-up to the 2006/07 NZHS, which used a representative sample of New Zealanders.[2]

2.4.2 Accident Compensation Corporation (ACC)

The ACC is a compulsory social insurance scheme that provides no-fault injury cover to all New Zealand residents and visitors to NZ. The ACC was founded in 1974, following a recommendation of the Woodhouse Report of 1967 and the gazetting of the Accident Compensation Act 1972. The ACC is a crown entity currently governed by the Accident Compensation Act (Accident Compensation Corporation 2017). Orofacial injuries can be recorded by dental or medical practitioners. Specific dental injuries are usually only recorded by a dentist or dental specialist and are recorded on a dental injury form (Appendix I). Details of injured teeth along with the relevant injury diagnoses are recorded, as well as site and nature of any soft-tissue or maxillofacial injuries. Injury diagnosis is based on the classification by Andreasen (Andreasen et al. 2007), and more than one injury can be recorded for each traumatised tooth. Sociodemographic information is also collected, along with a brief description of the cause of the injury. The pre-accident condition and whether the tooth has had a previous injury (if known or obvious) are documented. The overall condition of the patient's dentition including oral hygiene, caries activity and periodontal health, is also recorded. A new claim number and file is created for each new injury, even if the same teeth have been injured in a previous accident.

2.5 Classifications for dental trauma

There are many varying dental trauma classification systems in use which creates difficulties when comparing studies of dental trauma. A systematic review by Feliciano and de Franca Caldas (2006), showed that over 50 separate classification systems had been used in 164 epidemiological studies of dental trauma. The most frequently used system was Andreasen's (32%), which is a

[2] By using a multi-stage, stratified, probability-proportional-to-size (PPS) sample design (Ministry of Health 2010a).

modification of the World Health Organization (WHO) classification, followed by Ellis' (14%) and Garcia-Godoy's (6%) (Feliciano and de Franca Caldas 2006). Most of the literature examined in this thesis also used the Andreasen classification (Andreasen 1970; Zerman and Cavalleri 1993; Caliskan and Turkun 1995; Caldas and Burgos 2001; Wong and Kolokotsa 2004; Andreasen et al. 2007; Love and Ponnambalam 2008; Santos et al. 2010; Bucher et al. 2013; Atabek et al. 2014;). Other studies used the WHO classification (Davis and Knott 1984; Skaare and Jacobsen 2003), the National Institute of Dental Research (NIDR) index (Kaste et al. 1996; Shulman and Peterson 2004), or the criteria used for the Children's Dental Survey in the UK (Marcenes and Murray 2001; Frujeri et al. 2014). Some studies used modifications of these classifications (Borum and Andreasen 2001). Glendor et al. (1996) simplified the WHO classification into complicated and uncomplicated injuries, taking into account the risk of subsequent complications. The remainder of the studies examined in this review did not specify the classification used, or did not categorise the types of dental trauma.

There is no standard classification system for epidemiological studies of dental trauma, although suggestions have been proposed. Glendor et al. (2007) proposed a system to be used in epidemiological studies, based on the classification by Ellis and Davey (1970). In the conclusion of their systematic review, Feliciano and de Franca Caldas (2006) state that most classification systems are not applicable to epidemiological surveys, and the most suitable would be one based on Ellis' classification[3]. The authors add that including therapeutic procedures included in the classification system could be beneficial in epidemiological studies for determining treatment cost (Feliciano and de Franca Caldas 2006) (Appendix II classification examples).

[3] Feliciano and de Franca Caldas (2006) reference Ellis (1962) in a foreign language. This classification is presumed to be the same as by Ellis (1960) and Ellis and Davey (1970).

2.6 Prevalence of adult dental trauma

Prevalence is a measure of disease occurrence (Porta 2008). It is the proportion of cases or conditions in a given population at a particular time or period (Porta 2008). Prevalence is usually determined from cross-sectional studies or surveys, which can be clinical or self-reported in nature.

Despite the oral region comprising only 1% of the total body area, trauma to this site is relatively common (Eilert-Petterson et al. 1997). Oral injuries, including the dentition, soft tissues, maxilla and mandible, have been found to be the sixth most common body area for injuries, following injuries to the hands, feet, knees, head and face (Eilert-Petersson et al. 1997). Some 5% of all accidental injuries recorded for individuals of all ages in a large 12-month prospective study in Sweden were oral injuries, and 92% of these injuries included damage to the teeth (Eilert-Petersson et al. 1997). These findings are supported by a study in Israel by Lin and colleagues (2008), who found that 5% of all patients admitted to hospital for any traumatic injury had dental or maxillofacial injuries. Another study of facial injuries treated at an Austrian University hospital found that 48% included dental injuries (Gassner et al. 1999).

To assess the prevalence of dental trauma in a cross-sectional study, the occurrence of both treated and untreated dental injuries is evaluated. The prevalence of dental trauma in adults ranges from 13% to 28% in the literature. Cross-sectional studies of adults examined in this review differed by design and number of teeth assessed. The study by Kaste et al. (1996) showed that 28% of American adults aged 21-50 years had experienced trauma to at least one permanent incisor, and an overall prevalence of 25% in people aged 6-50 years. Shulman and Peterson (2004) found a similar prevalence of adult incisor trauma with the complete NHANES III data (27%). Locker (2007) used a self-report method and found that 16% of adults aged 18 to 50 years had experienced an injury to the mouth or teeth, and, of these, 85% reported that their worst injury included a dental injury (13% overall). Holland et al. (1994) found that 14% of 16-24-year-olds and 15% of 25-34-year-olds had at least one traumatised permanent incisor.

The reported prevalence of dental trauma of permanent teeth in children ranges from 6% to 24% and varied considerably depending on the study design and sample age (Burton et al. 1985; Burden 1995; Kaste et al. 1996; Locker 2007; Frujeri et al. 2014). Findings from the 2009 NZOHS data (already analysed) showed that 16% of children aged 7-17 years had one or more traumatised maxillary anterior permanent teeth. When age was separated into younger and older groups, the prevalence was found to be 6% for children aged 7-11 years, and 23% for children aged 12-17 years (Ministry of Health 2010b). Frujeri et al (2014) conducted a cross-sectional population-based study on 12-year-old children in Brazil, and found a prevalence of 15% of trauma to permanent teeth in children at public schools, and 23% in children at private schools (Frujeri et al. 2014). Burton et al. (1985) found a prevalence among adolescents enrolled at high schools in Northern Sydney of 6% for trauma of anterior permanent teeth. Marcenes and Murray (2001) found a dental trauma prevalence in permanent upper and lower incisors of 14-year-olds in a poor area of London of 24%.

2.7 Incidence of adult dental trauma

Incidence is the measure of the frequency of new events (for example, illness) that occur in a population over a specified period of time (Porta 2008). There are very few prospective studies that include dental trauma in adults. Previous research suggests that the majority of dental trauma occurs in childhood (Eilert-Petersson et al. 1997).

Oral injuries (dentition, mandible, maxilla and oral soft tissue) were found to have an overall incidence of 4.2/1000 inhabitants/year in a large prospective study in Sweden (Eilert-Petersson et al. 1997). In the same study, it was found that few oral injuries occurred after the age of 30, and the highest risk of oral injury occurred between 0 and 12 years, with an incidence of 18/1000 inhabitants/year. The incidence dropped to 0.5/1000 inhabitants/year for individuals over 30 years old. This was in contrast with non-oral injuries, which had the highest annual incidence in 13-19-year-olds (Eilert-Petersson et al. 1997).

In a similar prospective study, Glendor et al. (1996) found an incidence of 13 injury episodes per 1000 individuals per year (0-19 years) in the county of Västmanland, Sweden. The highest incidence occurred at age 2, 8 and 9 years old. One-third of the dental injuries in this study were severe injuries, including damage to the pulp and/or periodontal ligament (Glendor et al. 1996). Findings from a follow-up study in a different Swedish county showed that the annual incidence of dental injuries in children 8-10 years old increased between 2011 to 2013, and was significantly higher than the incidence in 1989/1990 observed in the study by Glendor et al. (1996) (Lexomboon et al. 2016). Skaare and Jacobsen (2003) reported a rate of almost 2% of new dental injuries registered during a one year period for 7-18-year olds in two regions of Norway.

2.8 Characteristics of dental trauma

Visible trauma to teeth can range from a small chip of the enamel, to a large dentine fracture with concomitant exposure of the pulp and dislocation. The most severe dental injuries involve both damage to the pulp and periodontal ligament. Overall treatment is often more complex, and the long-term prognosis of the tooth is often unclear due to restoration challenges and the risk of root resorption. Characteristics of dental trauma—including trauma type, number of teeth and the type of teeth involved—are discussed in the following paragraphs.

Studies reporting the prevalence of dental trauma characteristics based on a convenience sample or case series will not give the true prevalence of injury types. For instance, a small, non-painful tooth fracture may not prompt an individual to seek treatment, and so this injury type could be under-represented. Likewise, severe and painful injuries may be over-represented in clinics specialising in acute dental trauma. Alternatively, an injury may be acutely painful but the individual is unable to access care due to cost or distance. However, cross-sectional studies or surveys are not without limitations in this regard. A survey does not usually include investigation of previous dental records, thus information on previous injuries (such as luxation injuries) may not be collected.

Most studies of trauma to permanent teeth have found the most common injury to be fracture of the enamel and/or dentine, without an associated pulp exposure (Andreasen and Ravn 1972; Davis and Knott 1984; Liew and Daly 1986; Zerman and Cavalleri 1993; Caliskan and Turkun 1995; Kaste et al. 1996; Caldas and Burgos 2001; Marcenes and Murray 2001; Wong and Kolokotsa 2004; Locker 2007; Brunner et al. 2009; Bucher et al. 2013; Atabek et al. 2014; Dang et al. 2015). A retrospective study by Love and Ponnambalam (2008) and a prospective study by Skaare and Jacobsen (2003)—although not specifically studying adults—found that concussion was the most prevalent type of injury for permanent teeth. However, this may be a consequence of the precautionary practice of recording teeth either side of the obviously injured tooth or teeth as concussed in case future treatment is required, and therefore potentially overestimating concussion injuries. Conversely, some records of dental injuries may underestimate the extent of concussion of nearby teeth, especially if the patient presented some time after the trauma.

Some studies examined in this thesis reported that more severe injuries were the most frequent. Borum and Andreasen (2001) carried out a retrospective study on people of all ages presenting with dental trauma after-hours at an emergency clinic in Copenhagen, Denmark, and found that complicated injuries (which were defined as pulp exposures and/or luxations with dislocations) were most common. A similar study by Santos et al. (2010) in the state of São Paulo, Brazil, showed that avulsions were the most common dental injury in patients of all ages presenting to a hospital with oral and maxillofacial injuries. These findings most likely reflect the severity of trauma usually presenting at these clinics.

While tooth fractures are the most common dental injury occurring in the permanent dentition, luxation injuries are the most common in the primary dentition (Andreasen 1970; Andreasen and Ravn 1972; Bucher et al. 2012; Atabek et al. 2014). The relative elasticity and resilience of the alveolar bone and periodontal ligament has been proposed as a possible reason for this disparity (Andreasen 1970). As discussed above, this is important, since luxation injuries involving the primary dentition can potentially damage the developing permanent teeth.

Maxillary central incisors were the most frequently injured permanent teeth in the adult cross-sectional studies that recorded teeth affected by trauma (Kaste et al. 1996; Shulman and Peterson 2004). Holland et al. (1994) described more trauma occuring to maxillary incisors than mandibular incisors. A higher prevalence of truama in maxillary central incisors was a consistent finding in other studies including adults (Andreasen 1970; Davis and Knott 1984; Liew and Daly 1986; Caliskan and Turkun 1995; Love and Ponnambalam 2008; Caldas and Burgos 2001; Brunner et al. 2009; Bucher et al. 2013; Dang et al. 2015) and studies restricted to children examined in this thesis (Andreasen and Ravn 1972; Burton et al. 1985; Skaare and Jacobsen 2005; Chadwick et al. 2006; Atabek et al. 2014). In adults, the next most frequently affected teeth were the maxillary lateral incisors (Kaste et al. 1996; Shulman and Peterson 2004). Some larger population studies appeared to have clinical methods based on previous literature and examined only the anterior teeth, or even just the maxillary anterior teeth (Burden 1995; Caliskan and Turkun 1995; Kaste et al. 1996; Marcenes and Murray 2001; Shulman and Peterson 2004; Wong and Kolokotsa 2004; Chadwick et al. 2006).

A study of dental trauma in people 14 years and older (predominantly adults) registered with an insurance company in Switzerland also showed that maxillary incisors were most commonly affected by trauma (over 50% of dental injuries). However, it was found that posterior teeth contributed to a significant proportion of injured teeth, with maxillary and mandibular premolars and molars involved in approximately 20% of dental injuries (Brunner et al. 2009). Without having a good comparison, the authors suggested this could be due to the higher likelihood of premolars in adults having prior restorations and so being more predisposed to fracture from trauma than those in younger people.

Some cross-sectional studies examined in this thesis reported on the number of teeth affected by dental trauma. Some 50% of participants in the study by Kaste et al. (1996) (both adults and children) had evidence of only one traumatised incisor, while a survey of high-school students in Australia showed that 88% had only one injured tooth (Burton et al. 1985).

Other studies examined reported the number of teeth injured per traumatic episode. This is unable to be determined from a cross-sectional study, unless it was self-reported. The proportion of single-tooth injuries that were self-reported in the Locker (2007) study of adults was 47%. In other studies (mainly retrospective), the number of injured teeth per traumatic episode could differ depending on the clinical classification used, how the population was sampled, and whether the trauma was an acute or late presentation. Approximately half of traumatic injuries affecting only one tooth was a common finding in other studies (Caliskan and Turkun 1995; Skaare and Jacobsen 2005; Dang et al. 2015). In others, the proportion of single-tooth injuries was below 50%, which most likely reflected the severity of the trauma analysed in the study (Andreasen and Ravn 1972; Zerman and Cavalleri 1993).

Most studies showed no right or left side predilection (Skaare and Jacobsen 2003). However, studies by Shulman and Peterson (2004), Bucher et al. (2012), and Dang et al. (2015) revealed a higher prevalence of dental trauma of the right maxillary central incisor than the left.

2.9 Risk indicators

A risk indicator (or risk marker) is an association between an exposure and condition, which is determined using only cross-sectional studies (Beck 1998; Porta 2008). From the literature, risk indicators for orofacial trauma include age, sex, seasonal variation, socio-economic status, inadequate lip coverage, and a substantial overjet.

2.9.1 Age

Clinical population-based cross-sectional studies can report only on the presence of dental trauma at the time of the survey. Since dental trauma is cumulative in nature, findings would be expected to show an "increase" in prevalence with age. Some of the other studies examined in this thesis that did not follow a cross-sectional design reported on the age that dental trauma occurred.

The report by Kaste et al. (1996) on dental trauma in the USA found that the prevalence was associated with age, with a higher prevalence of dental trauma in people aged 21-50 years than 6-20 years. Among those aged 21-50 years, the prevalence was slightly lower in those aged over 31 years than those aged 21-30. The authors suggest that reasons for this finding could include recall bias and trauma recurring for the same people. Conversely, Locker's (2007) cross-sectional study showed no association between age and self-reported dental trauma experience.

Other types of studies examined in this thesis described the age that trauma occurred. Some showed that most dental trauma to permanent teeth probably occurs before adulthood. Eilert-Petersson et al. (1997) reported that the highest annual incidence of oral injuries in a Swedish population occurred between the ages of 0-12 years, and very few were recorded for people over the age of 30. Their study relied on people seeking treatment for their dental injury, and therefore there may have been a significant proportion of adults who sustained trauma but did not seek care. Data that have already been analysed from the 2009 NZOHS shows that 16% of children aged 7-17 years had at least one traumatised maxillary anterior tooth, and there was a higher prevalence in children aged 12-17 years (Ministry of Health 2010b). Although this does not describe the extent of dental trauma or number of teeth involved, it does support previous findings that most traumatic dental injuries probably occur before adulthood.

The Locker (2007) self-report study also included information about when the trauma had occurred. Two-thirds of 18-50-year-olds recalled the worst trauma to their permanent teeth to have occurred before 18 years of age. The self-reported ages of trauma in this study were: age 1 to 12 years, affecting 41% of those who had had trauma; age 13 to 17 years, affecting 24%; age 18 to 30 years, affecting 24%; and age 31 to 50 years, affecting 11% (Locker 2007). However, some studies reported a higher prevalence of dental trauma presenting in adults. Among retrospective studies examined in this thesis, Love and Ponnambalam (2008) found in Dunedin (NZ) that people aged 16 to 25 years old presented more frequently with trauma than other age groups. However, being a university

town, the population of young adults would have been disproportionate for that study, and this may explain the high number of young people presenting with dental trauma. A study of after-hours treatment of dental trauma in the Royal Newcastle Hospital in Australia revealed a similar finding, with people 18-23 years presenting more often (Liew and Daly 1986). Another study in Brazil explored dental trauma occurring in patients presenting with facial trauma and discovered that 28% occurred in the 20 to 29-year-old age group, and that 79% of the trauma recorded occurred before the fourth decade (Santos et al. 2010). Brunner et al. (2009) found a higher incidence of new trauma insurance claims in Swiss adults in the age groups of 30-39 in 1992, and 40-49 in 2002.

2.9.2 Sex

Most studies examined in this thesis revealed sex differences, and population-based studies of adults have shown that dental trauma is approximately 1.5-2 times more likely to be observed in males. Kaste et al. (1996) found males were approximately 1.5 times more likely than females to have had experienced dental trauma, while Locker (2007) found that twice as many males reported a previous injury to their mouth or teeth. Holland et al. (1994) reported just over twice as many adult males had trauma to incisors than females.

Other studies examined in this review (including studies of children) have also shown that dental trauma is more common in males (Andreasen and Ravn 1972; Burton et al. 1985; Liew and Daly 1986; Zerman and Cavalleri 1993; Caliskan and Turkun 1995; Kaste et al. 1996; Gassner et al. 1999; Caldas and Burgos 2001; Marcenes and Murray 2001; Skaare and Jacobsen 2003; Wong and Kolokotsa 2004; Locker 2007; Lin et al. 2008; Love and Ponnambalam 2008; Levin et al. 2010; Santos et al. 2010; Bucher et al. 2013; Atabek et al. 2014; Dang et al. 2015). However, a study that investigated dental and maxillofacial injuries in New Zealanders aged over 65 years showed that dental trauma was more common among the younger males in the study, but older females had a higher rate of facial fractures, and these could conceivably include concomitant dental trauma (Thomson et al. 2003).

2.9.3 Seasonal variation

Information about seasonal variation and dental trauma was not collected in the cross-sectional studies of adults examined in this thesis, but it was reported in some of the other study types. Eilert-Petersson et al. (1997) found the frequency of oral injuries to be highest in the October to January period, which is the northern hemisphere winter. The authors suspected that this indicates a higher risk of oral injury with winter sports. However, this was not reflected in the frequency of injuries to other parts of the body, which showed no seasonal variation. In contrast to non-oral injuries, oral injuries in 16-30-year-olds in the same study were more frequent in the weekends. Lexomboon et al. (2016) also found that the highest rates of dental trauma in Swedish children occurred in the winter, while the lowest occurred during the summer months. A study by Atabek et al. (2014) showed a higher rate of dental trauma during the summer months in Turkey. Love and Ponnambalam (2008) revealed that presentations of dental trauma at the Dental School clinic in Dunedin (NZ) had peaks corresponding with seasonal sports such as the winter sport of rugby union.

2.9.4 Socioeconomic status

There has been limited research at a population level investigating the relationship between socioeconomic status and dental trauma in adults. Locker (2007) found that there was no gradient by socioeconomic status, with higher rates found both among people with less than high school education and those with a graduate degree. Locker (2007) also found that more episodes of injury per person were associated with less education, and that treatment of the injury was more common in those who were more educated. Although prevalence rates in ethnic groups in the US were similar, Kaste et al. (1996) suggested a more thorough investigation of possible socioeconomic differences. Shulman and Peterson (2004) found the prevalence (analysing the complete NHANES III data) to be higher in Whites and non-Hispanic Blacks than Mexican-Americans, which could indicate a socioeconomic difference.

Socioeconomic status was shown to be a risk indicator in other studies examined in this thesis. Marcenes and Murray (2001) found that 14-year-olds from

overcrowded households in the UK had higher prevalence rates for dental injuries. In a trauma study in Israel by Levin et al. (2010), hospitalisation rates were lower in higher socioeconomic status areas for general trauma and for maxillofacial and dental trauma; however, this difference was statistically significant only for general trauma. A study of high-school children in two areas that differed in affluence in Northern Sydney (Australia) found that, although the prevalence of dental trauma was similar, there was a higher prevalence of untreated injuries requiring treatment in the less affluent area (29% in the less affluent area; 5% in the affluent area) (Burton et al. 1985). Other studies examined in this review (many involving children) found no difference in trauma prevalence by socioeconomic status (Frujeri et al. 2014; Blokland et al. 2016; Lexomboon et al. 2016).

2.9.5 Lip coverage and overjet

Anterior teeth that are more prominent and not protected by lip coverage have been found to have greater rates of dental trauma. Most studies have investigated children. Occlusal relationships were measured in only one population-based study of dental trauma in adults examined in this thesis. Shulman and Peterson (2004) found (using multivariate regression modelling of complete dataset from the NHANES III) that the odds of dental trauma were higher with greater overjet.

In studies including children, inadequate lip coverage and an overjet greater than normal (which varied among studies, ranging from a minimum of 3 to 5 mm) have been found to be associated with permanent tooth trauma. Hunter et al. (1990) found a higher prevalence of trauma to permanent maxillary incisors with a greater overjet, but did not find that lip coverage had any bearing on the prevalence of dental trauma. Dearing (1984) studied New Zealand children between 7.5 and 15 years old and who had been referred for orthodontic treatment, and found that children with fractured maxillary incisors had a significantly greater overjet (mean of 6.4mm, while it was 4.5mm in children without trauma). Dearing (1984) also found that trauma was more common

between the ages of 7 and 10, in males, and when less than half of the upper incisors were covered by the upper lip at rest.

2.9.6 Ethnicity

Few studies examined in this thesis recorded the ethnicity of participants. Ethnic disparities depend on the diversity of the population studied. Differences between ethnic groups can sometimes be an indication of socioeconomic differences. Using data from Phase One of the NHANES III, Kaste et al. (1996) reported there was a similar dental trauma prevalence between ethnic groups in both the younger and older age categories. However, analysis of the complete dataset some years later by Shulman and Peterson (2004) revealed that the prevalence was significantly higher in American Whites and non-Hispanic Blacks than in Mexican-Americans.

Two large NZ studies analysing consecutive cases of facial trauma have found Māori (who represent almost 15% of the NZ population[4]) to have higher rates. Koorey et al. (1992) investigated the incidence of facial fractures in NZ in the 1980s. The highest incidence of facial fractures was in Māori males, followed by Pacific Island males. Buchanan et al. (2005) found that NZ Māori males were twice as likely to present with maxillofacial trauma to Waikato Hospital as a consequence of interpersonal violence than were people from other ethnic groups. Alcohol was also implicated in more Māori patients than in non-Māori (46% and 28% respectively) (Buchanan et al. 2005). Dental trauma was not specifically examined in that study. However, a study by Gassner et al. (1999) showed that almost half of hospital admissions for maxillofacial trauma at an Austrian University clinic also had dental trauma. It is therefore conceivable that at least half of the patients with maxillofacial trauma admitted at Waikato Hospital could have also had dental injuries.

[4] NZ Census 2006. NZ Government. [accessed 2017 August 7]; http://www.stats.govt.nz/Census/2006CensusHomePage/QuickStats/quickstats-about-a-subject/national-highlights.aspx

2.9.7 Previous trauma

Several studies have suggested that previous trauma is a risk indicator for additional dental trauma, and support the theory that some people might be accident-prone. Locker (2007) found that previous trauma to any other part of the body requiring medical attention was significantly associated with a history of orofacial trauma. A cross-sectional study of 8-12-year-olds in Brazil found that dental trauma in the primary dentition was associated with a higher prevalence of dental trauma in permanent teeth in girls (Goettems et al. 2014). A prospective study of adolescents in Brazil showed those with prior dental trauma experience had a 4.9 greater odds than those without of presenting with further dental trauma (Ramos-Jorge et al. 2008).

2.10 Causes of dental trauma

Causes of dental trauma are not usually recorded in cross-sectional studies. This is because there might have been multiple traumatic episodes and different causes for different teeth, and causality is not able to be determined from a cross-sectional study. However, many of the other study types examined in this thesis (mainly retrospective) reported on dental trauma causes, and the most common were falls, motor vehicle accidents, sports and non-accidental contact (Eilert-Petersson et al. 1997; Gassner et al. 1999; Lin et al. 2008; Love and Ponnambalam 2008; Brunner et al. 2009; Levin et al. 2010; Bucher et al. 2012; Atabek et al. 2014). The majority found falls to be the primary cause among children and adults (Liew and Daly 1986; Caliskan and Turkun 1995; Petersson et al. 1997; Caldas and Burgos 2001; Thomson et al. 2003; Wong and Kolokotsa 2004; Love and Ponnambalam 2008; Bucher et al. 2013; Atabek et al. 2014; Lexomboon et al. 2016). Motor vehicle accidents accounted for the majority of injuries in two studies in Israel, but these studies were based on a case series of people admitted to hospital with maxillofacial trauma, and were likely to have included trauma from more severe accidents (Lin et al. 2008; Levin et al. 2010). Love and Ponnambalam (2008) showed in their case series that the most common causes of trauma to the permanent upper incisors were falls (21%), accidental contact (18%) and assault (17%). A similar study of ACC claims in NZ found that sports

were responsible for almost one-quarter of all new orofacial injury claims, with those aged 11-20 years having the highest proportion of sports-related claims (Welch et al. 2010).

2.11 Outcomes and implications of dental trauma

The outcomes of dental trauma can include pain, loss of tooth structure, loss of function, loss of vitality, displacement and aesthetic problems. Treatment is often required, which can include direct and indirect restorations, root canal treatment, splinting, extraction or replacement. Many of these treatments require multiple appointments, and can require monitoring and maintenance for life which is time-consuming and costly. The more severe outcomes of dental trauma are loss of the tooth or significant tooth structure due to the impact or subsequent resorption.

A traumatic injury to a tooth (or teeth) is often a painful and upsetting experience, especially if it occurs during childhood, and it may be the only dental experience for some. This could contribute to a negative perspective of all dental treatment. Similarly, a poor aesthetic result from trauma can have a psychological effect, because the trauma is most likely to affect the most prominent and visible teeth, the maxillary central incisors.

The outcomes of dental trauma are well documented, and they provide the basis for the current dental trauma management guidelines (Andreasen et al. 2007; Dental Trauma Guide 2017). The research in this field is considerable and will not be discussed in this literature review. These studies differ from epidemiological studies in that the samples are based on whether or not the participant has the injury. Cross-sectional studies and consecutive case series that recorded treatment or sequelae as result of the initial injury will be discussed in the following sections. Broadly speaking, the more severe the injury, the more severe the outcome, and delayed treatment was usually associated with a more negative outcome.

2.11.1 Treatment

In the studies examined, reports on treatment included whether there was evidence of repaired trauma, a recollection that dental treatment was sought, what treatment was done in relation to the type of dental injury, cost, and how much time the treatment required. Among the population-based studies, the majority of adults had a restoration or "repaired' trauma. Locker (2007) found that 79% of adults who had experienced dental trauma recalled receiving treatment from a health professional, and of those, 40% recollected treatment with a restoration. Kaste et al. (1996) found that of adults with dental trauma, 21% of traumatised teeth could be classified as having been "repaired" and 12% were "missing because of trauma". With increasing age, there was a higher proportion of teeth that were "missing due to trauma", and fewer "unrestored enamel injuries" (Kaste et al. 1996). Burton et al. (1985) found the majority of traumatised teeth of high school students in two areas of Northern Sydney to have remained vital (75%), while almost one-quarter were non-vital, and about 14% did not require treatment. As discussed earlier, almost one-third of students in a less-affluent area in Sydney had untreated injuries that required treatment (Burton et al. 1985).

Some of the retrospective studies revealed what treatment was provided along with the time involved. Atabek et al. (2014) found that 28% of injured permanent teeth in children treated in a Turkish university paediatric department during a 5-year period received root canal treatment, followed by 26% that received composite restorations. Although these studies analysed children, injuries and treatment to permanent teeth are a burden that will be carried into adulthood. Brunner et al. (2009) compared the treatment of dental trauma registered with the largest insurance company in Switzerland (SUVA) in the years of 1992 and 2002, and found a difference in treatment between the two groups. In 1992, most injuries were treated with fixed prosthodontics (such as crowns and bridges) but, in 2002, most were treated with direct composite restorations, and 36% required no treatment. An increase in treatment with implants was seen by 2002.

More severe injuries require more treatment time. Glendor et al. (1998) found that permanent teeth with uncomplicated trauma (using classification by Glendor et al. (1996)) required 9.2 visits and 3.2 hours for treatment, while complicated trauma required 16.4 visits and 8.5 hours.

2.11.2 Cost

Unlike injuries to many other parts of the body, the cost of treatment for permanent teeth can be on-going for life. Few studies have investigated the cost to the individual or society. Authors of a systematic review of dental trauma classifications recommended that therapeutic procedures be included in classifications for epidemiological studies in order to estimate treatment cost (Feliciano and de Franca Caldas 2006). Other studies utilised clinical records to estimate this. Wong and Kolokotsa (2004) estimated the cost of treating a child with an injury to one or more anterior permanent teeth at a dental hospital in the UK was 856 pounds (approximately 1540 USD in 2004). This did not include follow-up treatment or examinations. Borum and Andreasen (2001) estimated the costs associated with dental trauma based on patients seen at a major trauma centre in Copenhagen, Denmark. Describing trauma using the Glendor classification (Glendor et al. 1996) they found a relatively high proportion of complicated injuries to permanent teeth (40%), which is likely to be a reflection of the type of trauma presenting to the clinic, since it was the only service offering after-hours and emergency care at the time (Borum and Andreasen 2001). The treatment cost, which included immediate as well as follow-up treatment, was estimated to be 0.6 to 1 million USD per year for this clinic. A yearly cost for the estimated trauma population of Denmark was then estimated to be 2-5 USD per capita (Borum and Andreasen 2001). Two studies of dental trauma in Swedish children and adolescents showed that the severity of the injury and access to treatment influenced the direct and indirect time spent on care and costs of dental trauma. The average total cost per participant for traumatised permanent teeth in a two-year period was 4569 SEK (approximately $530 USD) (Glendor et al. 2000; Glendor et al. 2001).

2.11.3 Timing of treatment and outcomes

Most studies did not record the time between injury and treatment. Among the studies that did, the time between injury and treatment varied depending on the population studied and services available. A delay between the injury and treatment resulted in more complications and higher treatment needs. Atabek et al. (2014) (studying children) found that only 3% presented to the paediatric clinic at a university dental department in Turkey within one hour of the injury. The delay is thought to account for the high proportion of permanent teeth (28%) that required root canal treatment in this study (Atabek et al. 2014). Caliskan and Turkan (1995) discovered that only 30% of people aged 6-35 years in their study in Turkey sought treatment between one hour and 10 days after the dental trauma. This study also found a very high outcome of pulpal necrosis, especially in people presenting after 10 days (39%). In those presenting after 10 days, (11 days to 11 years after the trauma) 5% had internal or external resorption (Caliskan and Turkun, 1995). Conversely, Zerman and Cavalleri (1993) found that only 14% of 6-21-year-olds with dental trauma delayed seeking treatment at the University of Verona (Italy) Dental Clinic by one to seven days after the injury, while the remainder presented on the day of the trauma.

Two studies examined in this thesis reported on subsequent treatment in relation to the severity of the injury. In general, more serious injuries required more treatment or a less successful outcome. A retrospective study of children and adolescents carried out in 1972 to 1988 in Sweden reported outcomes related to the Glendor classification system (Glendor et al. 1998). The study revealed that in the first year following a dental injury, uncomplicated trauma (no pulpal exposure or displacement) to permanent teeth resulted in endodontic treatment in only 3% of the visits, while 67% of visits involved endodontic treatment when the trauma was complicated (pulpal exposure and/or displacement) (Glendor et al. 1998). Wong and Kolokosta (2004) investigated traumatised maxillary central incisors over a period of 11 years. They used the same classification as Glendor et al. (1998) and found that 97% of teeth with uncomplicated trauma had a successful outcome, which was defined as pulp

survival or completed root canal treatment (Wong and Kolokotsa 2004). An unsuccessful outcome was described as extraction (or a tooth planned to be extracted). Of the complicated injuries in this study, only 58% had a successful outcome (Wong and Kolokotsa 2004).

2.11.4 Quality of life

Trauma affecting the mouth and resulting in fractured, displaced and discoloured teeth can have negative functional, aesthetic and psychological effects. To date, there has been little research on the psychological impact of the appearance or function of traumatised teeth as time progresses, or on the subjective experiences and possible developments of dental anxiety related to treatment of the injury. A Scandinavian study of adults who had experienced dental trauma to permanent teeth 15 years previously when children reported some 28% with dental fear, with almost half recalling it was from treatment of their dental injury. Some 21% reported pain was felt during the treatment, and 21% remembered treatment required hours of missed school. Some 51% of females and 31% of males were unhappy 15 years later with the colour or shape of their traumatised or repaired teeth. Three-quarters of the participants reported they still thought about the dental trauma "often" or "sometimes". Almost 50% of females reported anxiety about the prognosis of their traumatised teeth, and a total of 13% participants reported the dental trauma had a negative impact on their social life. All participants who had needed a tooth extracted experienced problems with the replacement during adolescence (Robertson and Noren 1997).

A comparison study in Brazil by Cortes et al. (2002) revealed similar findings. They found that adolescents with untreated uncomplicated crown fractures were 20 times more likely to report the injury having an impact on daily activities than adolescents with no dental injury. Daily activities included eating and enjoying food, teeth cleaning, smiling, laughing and showing teeth without embarrassment (Cortes et al. 2002).

Another study in Brazil examined the impact of treatment on adolescents who had had an enamel and dentine fracture. A small cohort of adolescents was

followed to assess the impact of treatment on quality of life. The odds of the treatment having an impact on daily activities was 3.3 times greater than for adolescents without dental trauma. This finding report suggests that, although restoration of the traumatised tooth reduces the impact on daily life, it does not completely eliminate it (Ramos-Jorge et al. 2007).

2.12 Conclusion

Since damage to permanent teeth is not self-healing, injuries to permanent teeth and the sequelae of the trauma are carried into adulthood. Dental trauma can therefore be a life-long burden for the individual adult and society. There are few population-based studies internationally that have examined dental trauma in adults. The overall prevalence of dental trauma in adults—including people who have never sought treatment—is unknown in NZ. Moreover, it is not known whether the pattern of dental trauma at a population level follows that seen in studies internationally. The characteristics of dental trauma in NZ adults are also unknown, along with the nature and extent of sociodemographic differences in trauma occurrence or treatment. The 2009 NZOHS is a national cross-sectional study that has incorporated dental trauma for the first time. While some broad findings have been reported, there has been no in-depth analysis of the adult data. Data collected by the ACC is another unique source of dental trauma information which will complement the analysis of the 2009 NZOHS.

The research questions to be answered in this thesis are: (1) what are the prevalence characteristics of dental trauma in the NZ adult population; (2) what are the risk indicators; and (3) what treatment is carried out for dental trauma?

3 Methods

3.1 Introduction

This study was conducted in two parts. The first was a secondary analysis of the 2009 New Zealand Oral Health Survey (2009 NZOHS) dataset. This was a national survey based on a representative sample of New Zealand (NZ) adults. Self-reported and clinical data from adults (aged 18 years and over) on dental trauma were analysed to investigate its prevalence and risk indicators.

The second approach was an analysis of raw data from NZ's compulsory insurance scheme, the Accident Compensation Corporation (ACC). This was included in this thesis to complement the population-level findings. Analysis was conducted on data collected about new dental injuries recorded within a specified period, along with data on subsequent treatment recorded for a sample of them.

3.2 The New Zealand Oral Health Survey (NZOHS)

3.2.1 Study design

The methodology used by the Ministry of Health (MOH) for the 2009 NZOHS is summarised below (Ministry of Health 2010a).

The 2009 NZOHS was a cross-sectional survey on a representative sample of the NZ population, and was the first national survey of NZ oral health to be carried out since 1981[5]. To date, it is the best and most recent source of oral health information on the NZ population. The survey consisted of a questionnaire administered by a face-to-face interview and a clinical dental examination. Some 4,906 NZ adults and children participated in a face-to-face interview, and 3,196 of these participants also had a dental examination. A total of 2,209 adults aged 18 years and over completed both the interview and the dental examination.

The 2009 NZOHS was a follow-up to the population-based 2006/07 New Zealand Health Survey (NZHS).

3.2.2 Sample

The sample design used in the NZHS, and thus the NZOHS, was developed by the Centre for Statistical and Survey Methodology, University of Wollongong, NSW, Australia. The target population for the 2006/07 NZHS was the non-institutionalised civilian population of NZ (approximately four million people). A small number of private dwellings were excluded in the survey population, either because they were situated off the main islands of NZ or were included in meshblocks with fewer than nine occupied dwellings. Therefore, the survey population was 98.9% of the target population. The sample frame for the 2009 NZOHS included households surveyed in the 2006/07 NZHS that permitted re-contact for future surveys (Figure 1).

[5] Ministry of Health. NZ Government. [accessed 2017 July 15]; http://www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/surveys/current-recent-surveys/oral-health-survey

Approximately 1,385 meshblocks were randomly chosen for the 2006/07 NZHS. Larger geographic areas and areas with higher proportions of Māori, Pacific or Asian people had an increased chance of selection. More than four out of five households (84%) agreed to be re-contacted for future health surveys. All Māori, Pacific and Asian participants that permitted re-contact for future surveys were selected for the 2009 NZOHS. Two in five European/Other participants were selected. A total of 8,938 people in total were selected to participate in the 2009 NZOHS (Figure 1).

Some 3,475 adults aged 18 years and over participated in the interview, and those who were dentate were invited to have a dental examination. A total of 2,209 adults participated in both the interview and the dental examination (Figure 1).

Figure 1. Diagram showing the sample for the 2006/07 NZHS and 2009 NZOHS

3.2.3 Ethical approval

The NZ Health and Disability Multi-Region Ethics Committee granted ethical approval for the 2009 NZOHS (MEC/07/11/149)[6]. Additional ethical approval for the secondary analysis of these de-identified data was granted by the University of Otago (D17/042) (Appendix III).

3.2.4 Response rate

The weighted response rate for participants 18 years and over was 70% for the interview, and 84% for the dental examination (of those who participated in the interview). However, because the 2009 survey was based on the sampling frame of the 2006/07 HS—which had a response rate of 68% for adults—the overall response rate for the 2009 NZOHS was 49% for the interview and 41% for the examination.

3.2.5 Interview design

The adult questionnaire contained 129 questions about oral health divided into five topics, including orofacial trauma, which was included in the oral health survey for the first time. The orofacial trauma section included self-reported history of orofacial trauma and dental trauma, dental care following dental trauma, reasons for not seeking dental care, function, appearance and of repaired teeth, awareness and uptake of ACC contribution to dental injury costs (Table 2).

3.2.5.1 Sociodemographic variables

Sociodemographic information was collected in the interview. Characteristics included sex, age, ethnicity, deprivation and education. Participants were able to select more than one ethnic group, and so a total response for ethnicity was used in this study. Prioritised data on ethnicity were not available.

[6] Ministry of Health (2010a)

3.2.5.2 Dental trauma variables

Participants were asked a number of questions on their history of dental trauma (Table 2). Participants were given response options to choose from (Appendix IV).

Table 2. Orofacial trauma topics (interview questionnaire)

Questionnaire topics	
Orofacial trauma history	Injury involving the orofacial region How long ago did it occur
Dental trauma history	Injury to the teeth Type of dental injury Whether treatment was sought Reasons for not seeking treatment Function and aesthetics after treatment
Related to dental trauma	Knowledge of ACC cover for dental injuries ACC contributed to treatment costs Use of mouthguards for sport

3.2.6 Clinical examination design

The maxillary six anterior teeth were examined for signs of dental trauma (teeth 13, 12, 11, 21, 22, 23). Participants were asked about any history of trauma to their "upper front teeth", and this was followed by an examination to verify that.

3.2.6.1 Clinical dental trauma variables

The following codes were appointed to each tooth maxillary anterior tooth. Teeth lost due to trauma and other causes were also included; therefore six codes were recorded for each participant examined (Table 3).

Table 3. Clinical dental trauma variables

Code	Observation
0	No trauma
1	Treated trauma: any size or involvement (usually with composite)
2	Trauma limited to enamel and not treated
3	Trauma involving at least dentine (treatment required but not yet treated)
4	Tooth discoloured after trauma (verified by patient)
5	Avulsed, luxated because of trauma (verified by patient)
6	Not able to be scored (primary tooth, unerupted tooth, tooth missing for reasons other than trauma)

3.2.7 Data collection

3.2.7.1 Interview

Participants 15 years and over took part in the adult questionnaire via a computer-assisted face-to-face interview. For the purposes of this study, only data concerning adults aged 18 years and over were analysed. Participation in the oral health survey was voluntary, and potential participants were contacted initially by an invitation letter and then followed up by contact from the interviewers. The interviewers conducted up to nine call-backs, which included one to three home visits at different times of the day when a home address was available. Contact was attempted for potential participants via multiple contact details. Consent was obtained at the time of the interview.

The interview was carried out in participants' homes, and took place between February and December 2009. Some 39 interviewers from a research company (CBG Health Research Ltd) were used for the 2009 survey. Pre-determined responses to the interview questions were displayed on show cards where appropriate. Interpreters were provided when needed, and answers were

recorded directly into a laptop computer by the interviewer. The adult interview time was an average of 31 minutes.

3.2.7.2 Dental examination

Interview participants who were dentate were invited to attend a dental examination. Some 2,209 adults 18 years and older participated in the examination, and these were conducted by 22 dentists with current registration and practising certificates. An international expert in examiner training for population-based oral health surveys headed the team. The team also included a gold standard examiner, whose role was to conduct repeat examinations for about six survey participants per examiner. Examiners attended a two-and-a-half-day training course with the international expert. Most examiners conducted 50-200 examinations each, with a median of 117. The interviewers from CBG Health Research Ltd attended the clinical examinations as dental recorders, and also attended the training course.

Approximately 84% of the examinations took place within six weeks of the interview. Failure to attend an appointment for an examination was followed up, and 90% of such participants completed the examination at the second appointment. No more appointments were made if they failed to attend their second. Participants who completed a dental examination were sent a $50 (NZD) voucher to cover any travel costs.

The majority of the dental examinations took place in a dental facility, such as a private dental practice, DHB clinic, School Dental Service clinic or iwi[7]-provider clinic. The clinical examination took place in standard dental chairs in participating clinics with overhead dental lights. The Australian National Survey of Adult Oral Health 2004-06 examination protocols were used. Instruments included an intra-oral mirror containing a battery-powered light source, and a periodontal probe with 2mm markings. No radiographs were taken.

[7] Māori tribe (Stats NZ. [accessed 2017 August 11]; http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/iwi/definition.aspx

A small number (approximately 0.5%) of dental examinations were conducted in participants' own homes if they were physically unable to travel, and these were all carried out near the end of the survey period by a single examiner.

On completion of the examination, participants were given a report outlining the main clinical findings, as well as advice about dental care. In cases where a malignancy was suspected, the participant was referred for further investigation.

3.2.8 Training and calibration of interviewers and examiners

Interview questions that had not been used in previous NZ oral health surveys (including questions about dental trauma) were tested in a pilot study in 2008. The pilot study was carried out on 100 participants from the survey sample frame and tested both the interview and dental examination. Adjustments were then made. These participants were excluded from the 2009 OHS.

The interviewers had five training days prior to the 2009 survey. The survey was then tested again by way of a dress rehearsal which took place in February 2009. Twelve randomly selected meshblocks in Northland were used and generated 24 interviews. These participants were included in the full survey, since no "major issues" were found.

Variation among examiners was minimised by using the examination protocol manual, training and calibration, and re-calibration by the gold standard examiner if there had been a delay between training and starting the examinations. Examiner inter-reliability was measured per examiner, relative to the gold standard examiner. Intra-class correlation coefficients (ICC) and kappa statistics were used to determine the degree of inter- and intra-examiner reliability.

3.2.9 Data analysis

3.2.9.1 Overview

The statistical programme Stata (version 14.1) was used for analysis, and survey methods appropriate to complex, weighted data sets were used. Descriptive statistics were generated, and cross-tabulations of the cross-sectional survey data were done to describe the survey population, and to examine the characteristics and prevalence of dental injuries. Multivariate logistic regression was used to determine associations between putative risk factors and outcomes. (Stata programming files Appendix V)

3.2.9.2 Data management

The adult dataset was made available from the MOH and delivered via a USB storage device. It did not contain any participant-identifying information. The dataset was then stored on the primary supervisor's (WMT) and candidate's computers.

Survey weights were taken into account by the statistical software Stata for all of the analyses, and the Stata syntax for weights was provided by the MOH. Weighting is common in analysis of population-based studies, to ensure that estimates are representative of the overall population (that is, the resident NZ population). The 95% confidence interval was applied for all analyses, and observed differences were considered to be statistically significant if $P<0.05$.

Only data on adults 18 years and older who participated in the face-to-face interview and clinical examination were analysed in this study. Ethnic comparisons were run separately because prioritised ethnicity was not used, meaning that participants could belong to more than one ethnic group.

3.2.9.3 Descriptive studies

Key sociodemographic characteristics (sex, age, ethnicity, deprivation and education) were represented by categorical variables (all ordinal, except for sex). Estimates for categorical variables were expressed as percentages with

confidence intervals and those for continuous variables were expressed by means and confidence intervals. Cross-tabulations were conducted to compare prevalence estimates. The chi-square test was used to assess the significance of differences in proportions.

3.2.9.4 Logistic regression modeling

Multivariate logistic regression (with the logistic procedure in Stata) was used to analyse both the self-reported and clinical data in order to reveal adjusted associations between the putative risk factors (sex, age, ethnicity, deprivation and education) and the outcome (dental trauma).

3.2.9.5 Independent variables

Deprivation was determined by the New Zealand Index of Deprivation 2006 (NZDep2006)[8] and described from quintile 1 (least deprived) to quintile 5 (most deprived. Education was based on the highest education level achieved by each participant (Table 4).

[8] Salmond C, Crampton P, Atkinson J. 2007. NZDep2006 Index of Deprivation. Wellington: Department of Public Health

Table 4. 2009 NZOHS independent variables

Independent variables	
Sex	Male Female
Age group (years)	18-24 25-34 35-44 45-54 55-64 65-74 75+
Ethnicity	European/other Māori Pacific Asian
Deprivation	1 (least deprived) 2 3 4 5 (most deprived)
Highest education level	Primary (ages 5-13) Secondary (ages 13-18)/vocational University

3.2.9.6 Dependent variables

Dependent variables were taken from the 2009 NZOHS interview questionnaire. They included a choice of pre-determined answers to the following questions (Table 5).

Table 5. 2009 NZOHS dependent variables (questionnaire)

Dependent variables	
Orofacial trauma	History of orofacial trauma How long ago did the trauma happen
Dental trauma	History of dental trauma Type of dental injury (codes given as per survey guideline) Whether treatment was sought Function and aesthetics after treatment ACC (insurance) payment for treatment
All survey participants	Knowledge of ACC cover for dental treatment Use of mouthguards for contact sport

Dependent variables were taken from the 2009 NZOHS methodology for the clinical examinations and included visual signs of dental trauma for each of the maxillary anterior teeth (13-23). One of the following codes was assigned to each tooth (Table 6).

Table 6. Dependent variables (clinical examination data)

Code	Observation
0	No trauma
1	Treated trauma: any size or involvement (usually with composite)
2	Trauma limited to enamel and not treated
3	Trauma involving at least dentine (treatment required but not yet treated)
4	Tooth discoloured after trauma (verified by patient)
5	Avulsed, luxated because of trauma (verified by patient)
6	Not able to be scored (primary tooth, unerupted tooth, tooth missing for reasons other than trauma)

3.3 The Accident Compensation Corporation Study

3.3.1 Study design

This was a consecutive case series analysed with the purpose of providing descriptive information to complement the 2009 NZOHS findings.

3.3.2 Sample

Two datasets were received from the ACC. The first contained all new dental injuries recorded from the 1st January 2008 until the 31st December 2008. The second consisted of all treatment claimed in the five years following the initial injury, for all new injuries recorded in the month of June 2008 (1st June to 30th June). The purpose of this was to provide follow-up information for a subset of the 2008 data in order to examine outcomes described by the treatment claimed.

3.3.3 Ethical approval

Ethical approval from ACC was required to obtain the data, as claim numbers were required to identify subsequent treatment (Appendix VI). However, there were no patient-identifying details included in the information such as names and contact details.

3.3.4 Dental trauma variables

3.3.4.1 Independent variables

Independent variables were taken from the first and second page of the ACC42 form (Appendix I) dental injury form and included sex, age, ethnicity and injured tooth notation number. Teeth included any permanent teeth including third molars. The age when injured was categorised by age group (Table 7).

Table 7. Independent variables for the ACC data

Variables	
Permanent teeth (FDI notation)	18-28 and 38-48 (14-24 and 33-43 used for June data)
Age group (years)	18-24 25-34 35-44 45-54 54-64 65+
Sex	Male Female
Ethnicity (one per claimant)	Māori Pacific Asian European Other Residual categories

Teeth posterior to first premolars in the maxilla and canines in the mandible were excluded for the analysis of the June data because they were found to be infrequently involved in dental trauma.

3.3.4.2 Dependent variables

Dependent variables were based on the injury classification from the ACC42 dental injury form (Table 8).

Table 8. Dependent variables for the ACC data

Dependent variables	
Injury type	Dental Soft tissue Alveolar bone/jaw/TMJ
Teeth injury classification	Andreasen classification
Number of injury classifications per tooth	
Treatment codes for teeth injured in June	(Accident Compensation Corporation 2016)
Number of treatment codes per injured tooth (June data only)	

Dental injuries recorded on the ACC42 form are categorised according to the Andreasen classification (Andreasen et al. 2007). This gives a possibility of 12 injury classifications per tooth. Due to multiple injuries recorded for some teeth, for instance, both concussion and enamel-dentine fracture, the data were very difficult to analyse. A new system of categorising the injuries in order of severity and risk of complications was devised, based on previous work by Andreasen and colleagues (Andreasen et al. 2007). The new classification contained injuries described in Table 9, with minor injuries being the least severe.

Table 9. Classification for ACC dental injuries for this study

Classification	Injuries as listed on the ACC42 form
Minor injury	Concussion Enamel infraction Enamel fracture
Fracture or loosening	Enamel-dentine fracture Subluxation Root fracture
Severe fracture	Complicated crown fracture Crown-root fracture
Displacement	Extrusive luxation Lateral luxation
Severe displacement	Avulsion Intrusive luxation

The June treatment dataset also contained a vast amount of complex information. There are 82 ACC dental treatments in total, and each injured tooth could have had multiple treatments per tooth over the 5-year period. For the purposes of this study, only treatment variables such as completed root canal treatment, extraction and implant placement were examined. The ACC Cost of Treatment Regulations (Accident Compensation Corporation 2016) were used to create the variables (Table 10).

Table 10. ACC treatment variables

Variables	Regulation description (Accident Compensation Corporation 2016)
Root canal treatment	Complete preparation and obturation of root canal (per canal)
Extraction	Extraction of tooth; Surgical removal of tooth
Implant	Definitive abutment

3.3.5 Data analysis

ACC analysts arranged the raw data in a spreadsheet format with dental injury classifications and treatment by injured tooth for each separate claim number. The spreadsheets were then emailed to the lead researcher as a password-protected file. The spreadsheets were stored on the primary supervisor's (WMT) and candidate's computers. The data were then imported into the statistical programme SPSS (Version 24) and analyses were conducted. Descriptive analyses and cross-tabulations were undertaken for this dataset. (SPSS programming files Appendix VII)

3.3.6 Descriptive studies

Frequency distribution and cross-tabulation of the data were undertaken to determine the distribution of the types of dental injury recorded with ACC, and examine the distribution of treatment according to the severity of the injury.

4. Results

4.1 Descriptive analysis of dental trauma in adults (2009 New Zealand Oral Health Survey questionnaire data)

Data from the face-to-face interview in the 2009 NZOHS are presented in this section.

The sociodemographic characteristics of the NZ adult population are presented in Table 11.

Table 11. Sex by other sociodemographic characteristics (data are row percentage unless otherwise indicated; brackets contain 95% CI)

	Sex		
	Female	Male	Both combined[b]
Age group			
18-24	54.6 (48.0, 61.0)	45.4 (39.0, 52.0)	13.1 (11.5, 14.8)
25-34	52.1 (46.6, 57.6)	47.9 (42.4, 53.4)	16.9 (15.0, 19.1)
35-44	53.2 (49.3, 57.1)	46.8 (42.9, 50.7)	22.6 (20.9, 24.4)
45-54	53.1 (48.9, 57.3)	46.9 (42.7, 51.1)	20.0 (18.4, 21.8)
55-64	46.7 (41.8, 51.7)	53.3 (48.3, 58.2)	13.8 (12.5, 15.2)
65-74	53.7 (47.9, 59.4)	46.3 (40.6, 52.1)	7.9 (6.9, 9.1)
75+	51.2 (44.6, 57.7)	48.8 (42.3, 55.4)	5.6 (4.9, 6.4)
Ethnic group			
Māori	54.2 (52.4, 55.9)	45.9 (44.1, 47.6)[c]	11.1 (10.7, 11.5)[a]
Pacific	55.5 (53.5, 57.5)	44.5 (42.5, 46.5)[c]	5.3 (5.1, 5.5)
Asian	43.6 (34.1, 53.6)	56.4 (46.4, 65.9)	10.2 (8.2, 12.6)
European/Other	52.8 (51.4, 54.3)	47.2 (45.7, 48.6)	82.1 (79.9, 84.1)
Deprivation quintile			
1 (least deprived)	49.5 (43.1, 56.0)	50.5 (44.0, 56.9)	21.2 (19.4, 23.1)
2	51.8 (45.4, 58.3)	48.2 (41.8, 54.6)	21.9 (20.1, 23.9)
3	55.0 (48.6, 61.2)	45.1 (38.8, 51.5)	19.2 (17.4, 21.2)
4	50.8 (44.5, 57.1)	49.2 (43.0, 55.5)	20.2 (18.4, 22.0)
5 (most deprived)	54.5 (47.6, 61.2)	45.5 (38.8, 52.4)	17.5 (16.0, 19.2)
Highest education level			
Primary	57.1 (48.0, 65.8)	42.9 (34.2, 52.0)	9.7 (8.3, 11.4)
Secondary/vocational	52.0 (49.6, 54.5)	48.0 (45.5, 50.4)	68.6 (66.1, 71.0)
University	52.2 (43.8, 57.3)	47.8 (42.7, 56.2)	21.7 (19.4, 24.2)
All combined	52.2 (51.3, 53.1)	47.8 (46.9, 48.7)	100.0

[a]In this table and subsequent ones, the column percentage for the four ethnic categories do not sum to 100 because (1) participants were able to choose more than one ethnic group, and (2) I was not permitted to use prioritised ethnic group
[b]Column percentage
[c]P<0.05

Males and females were approximately equally represented across the categories of the other sociodemographic characteristics. The exceptions were Māori males and Pacific males, who were significantly under-represented. Data on ethnic group by other sociodemographic characteristics are presented in Table 12.

Table 12. Ethnicity by other sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Ethnic group			
	Māori	Pacific	Asian	European/Other
Sex				
Female	11.5 (11.0, 11.9)[a]	5.6 (5.3, 6.0)[a]	8.5 (6.3, 11.4)	83.1 (80.4, 85.4)
Male	10.6 (10.0, 11.3)	4.9 (4.7, 5.2)	12.1 (9.0, 16.0)	81.0 (77.3, 84.3)
Age group				
18-24	17.6 (14.3, 21.5)[a]	6.1 (4.0, 9.2)[a]	21.0 (12.0, 33.9)[a]	72.1 (60.6, 81.2)[a]
25-34	15.2 (12.6, 18.22)	7.8 (5.7, 10.6)	17.0 (11.1, 25.2)	71.9 (64.0, 78.6)
35-44	13.0 (11.4, 14.8)	5.7 (4.5, 7.1)	7.6 (5.8, 9.9)	83.5 (80.6, 85.9)
45-54	9.0 (7.7, 10.5)	5.6 (4.3, 7.4)	8.4 (6.3, 11.2)	82.7 (79.1, 85.7)
55-64	6.8 (5.3, 8.8)	3.3 (2.1, 5.3)	5.6 (3.8, 8.3)	89.4 (86.5, 91.7)
65-74	5.1 (3.8, 6.9)	1.8 (0.8, 4.2)	4.0 (2.1, 7.3)	93.3 (89.3, 95.9)
75+	1.8 (1.0, 3.2)	2.9 (1.6, 5.2)	2.0 (0.7, 5.8)	94.5 (90.9, 96.7)
Deprivation quintile				
1 (least deprived)	4.8 (3.4, 6.6)[a]	0.9 (0.4, 2.0)[a]	5.8 (3.1, 10.6)	93.2 (88.5, 96.0)[a]
2	7.2 (5.8, 8.9)	2.5 (1.5, 4.1)	11.1 (7.6, 15.8)	86.1 (81.5, 89.8)
3	9.7 (7.6, 12.4)	3.9 (2.3, 6.4)	9.3 (5.8, 14.8)	85.5 (80.3, 89.6)
4	13.6 (11.0, 16.8)	3.7 (2.5, 5.5)	14.2 (9.9, 19.8)	78.6 (73.3, 83.0)
5 (most deprived)	22.1 (18.2, 26.6)	17.5 (14.7, 20.7)	10.9 (7.2, 16.2)	63.9 (57.4, 69.9)
Highest education level				
Primary	22.8 (18.5, 27.7)[a]	13.1 (9.4, 18.0)[a]	2.8 (1.5, 5.4)[a]	73.5 (67.7, 78.5)[a]
Secondary/vocational	10.7 (9.8, 11.6)	5.3 (4.6, 6.1)	9.5 (7.3, 12.3)	83.7 (81.1, 85.9)
University	7.0 (5.6, 8.8)	1.8 (1.1, 3.1)	15.7 (11.7, 20.9)	80.9 (75.7, 85.2)
All combined	11.1 (10.7, 11.5)	5.3 (5.1, 5.5)	10.2 (8.2, 12.6)	82.1 (79.9, 84.1)

[a]P<0.05

Overall, the European/other group had a larger proportion of participants. There were more females than males in the Māori and Pacific groups. A greater proportion of Māori, Pacific and Asian people were in the younger age groups than in the older ones. Conversely, more European/other people were represented in the older age groups than in the younger ones. A greater proportion of Māori participants lived in deprived areas, and had received only a primary school education. Similarly, a higher proportion of Pacific people were deprived, and fewer had secondary or university education. A higher proportion of Asian people were in the 18-24 and 25-34 age groups than in the older ones. More Asian people had achieved secondary or university education than only a primary one. There was a higher proportion of European/other participants in the 35-44 group and older groups. More European/other people were in the least deprived group than the most deprived one. A higher proportion of European/other participants had achieved secondary education than a primary one. Data on age group by sociodemographic characteristics are presented in Table 13.

Table 13. Age groups of NZ adults by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Age group						
	18-24	25-34	35-44	45-54	55-64	65-74	75+
Sex							
Female	13.7 (11.6, 16.0)	16.9 (14.6, 19.5)	23.0 (20.9, 25.30	20.4 (18.5, 22.4)	12.4 (10.8, 14.1)	8.2 (6.9, 9.6)	5.5 (4.5, 6.7)
Male	12.4 (10.2, 15.0)	17.0 (14.0, 20.4)	22.1 (19.5, 25.0)	19.7 (17.0, 22.7)	15.4 (13.4, 17.7)	7.7 (6.9, 9.1)	5.8 (4.8, 6.8)
Ethnic group							
Māori	20.8 (17.8, 24.1)	23.3 (19.9, 27.0)	26.5 (23.4, 29.8)	16.3 (14.0, 19.0)	8.6 (6.7, 10.9)	3.7 (2.8, 4.7)	0.9 (0.5, 1.6)[a]
Pacific	15.0 (9.8, 22.3)	25.0 (18.1, 33.5)	24.3 (19.3, 30.1)	21.4 (16.1, 27.8)	8.6 (5.5, 13.4)	2.7 (1.2, 6.1)	3.1 (1.7, 5.5)
Asian	26.8 (17.8, 38.2)	28.2 (19.9, 38.2)	22.6 (20.9, 24.4)	20.0 (18.4, 21.8)	13.8 (12.5, 15.2)	3.1 (1.6, 5.8)	1.1 (0.4, 3.2)
European/Other	11.5 (9.4, 13.9)	14.8 (12.6, 17.3)	23.0 (20.8, 25.2)	20.2 (18.3, 22.3)	15.1 (13.4, 16.8)	9.0 (7.7, 10.5)	6.5 (5.6, 7.5)
Deprivation quintile							
1 (least deprived)	4.8 (1.6, 13.1)	14.8 (10.1, 21.0)	23.8 (18.4, 30.3)	24.9 (19.7, 31.0)	19.2 (14.5, 24.9)	8.1 (5.6, 11.5)	4.5 (2.7, 7.6)[a]
2	16.5 (11.7, 22.9)	9.7 (6.2, 14.8)	20.9 (16.3, 26.4)	23.5 (18.0, 30.1)	13.3 (9.4, 18.6)	10.0 (7.0, 14.1)	6.1 (4.1, 9.0)
3	12.9 (7.7, 20.7)	18.8 (13.2, 26.0)	23.9 (18.9, 29.9)	18.7 (14.3, 24.2)	9.4 (6.7, 12.8)	9.4 (6.6, 13.0)	7.0 (4.5, 10.8)
4	12.3 (8.0, 18.5)	22.4 (16.1, 30.3)	24.6 (19.2, 31.0)	13.0 (9.5, 17.5)	15.3 (11.3, 20.5)	5.9 (3.7, 9.1)	6.4 (4.1, 10.0)
5 (most deprived)	19.8 (13.9, 27.4)	20.3 (15.2, 26.5)	19.4 (15.5, 24.0)	19.4 (14.4, 25.6)	11.2 (7.5, 16.2)	6.0 (4.0, 8.9)	4.0 (2.5, 6.4)
Highest education level							
Primary	11.9 (6.5, 20.8)	5.7 (3.4, 9.3)	16.1 (11.7, 21.8)	21.1 (15.0, 28.8)	21.7 (15.7, 29.1)	10.8 (7.0, 16.2)	12.9 (8.8, 18.6)[a]
Secondary/vocational	15.2 (12.9, 17.9)	16.9 (14.3, 19.9)	20.9 (18.5, 23.6)	20.8 (18.8, 23.0)	12.2 (10.5, 14.1)	8.4 (7.0, 10.0)	5.6 (4.6, 6.8)
University	6.7 (3.6, 12.2)	22.0 (17.3, 27.5)	30.7 (25.4, 36.6)	17.2 (13.3, 22.0)	15.6 (11.6, 20.6)	5.2 (3.1, 8.5)	2.6 (1.3, 4.8)
All combined	13.1 (11.5, 14.8)	16.9 (15.0, 19.1)	22.6 (20.9, 24.4)	20.0 (18.4, 21.8)	13.8 (12.5, 15.2)	7.9 (6.9, 9.1)	5.6 (4.9, 6.4)

[a]P<0.05

Overall, there were more participants in the 35-44 and 45-54 age groups. The 75+ age group was relatively under-represented. There was a smaller proportion of Māori in the 65-74 and 75+ age groups. There was a greater proportion with a University education in the 35-44 age group. The 35-44 age group did not vary much by deprivation, however the younger age groups were more likely to be more deprived, and the 45-54 and 55-64 groups were more likely to be least deprived. Primary school education by age group showed an "inverse U-shaped curve", with rates of secondary and university education highest in the 35-44 age group. A relatively small proportion in the two oldest age groups had achieved more than primary education. Data on adult experience of orofacial trauma are presented in Table 14.

Table 14. Orofacial trauma experience by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Ever had trauma	
	Yes	No/Don't know
Sex		
Female	31.4 (27.9, 35.1)	68.6 (64.9, 72.1)[a]
Male	51.3 (45.8, 56.8)	48.7 (43.2, 54.3)
Age group		
18-24	30.4 (20.5, 42.5)	69.6 (57.5, 79.5)[a]
25-34	41.0 (33.1, 49.5)	59.0 (50.6, 66.9)
35-44	49.4 (43.1, 55.8)	50.6 (44.3, 56.9)
45-54	44.6 (37.4, 52.1)	55.4 (47.9, 62.6)
55-64	36.3 (29.2, 44.1)	63.7 (55.9, 70.9)
65-74	41.7 (33.1, 50.9)	58.3 (49.1, 66.9)
75+	27.7 (19.2, 38.3)	72.3 (61.7, 80.8)
Ethnic group		
Māori	47.2 (42.4, 52.2)	52.8 (47.8, 57.6)[a]
Pacific	30.1 (23.9, 37.2)	69.9 (62.8, 76.1)[a]
Asian	25.3 (18.0, 34.4)	74.7 (65.6, 82.0)[a]
European/Other	43.5 (37.6, 44.2)	56.5 (52.7, 60.3)[a]
Deprivation quintile		
1 (least deprived)	41.4 (34.7, 48.5)	58.6 (51.6, 65.3)
2	46.4 (39.7, 53.2)	53.6 (46.8, 60.3)
3	36.1 (29.7, 42.9)	63.9 (57.1, 70.3)
4	38.4 (31.8, 45.5)	61.6 (54.6, 68.2)
5 (most deprived)	41.6 (34.2, 49.4)	58.4 (50.6, 65.9)
Highest education level		
Primary	33.3 (25.9, 41.7)	66.7 (58.3, 74.2)
Secondary/vocational	41.9 (38.5, 45.4)	58.1 (54.6, 61.5)
University	41.0 (33.9, 48.5)	59.0 (51.5, 66.1)
All combined	40.9 (37.6, 44.2)	59.1 (55.8, 62.4)

[a]P<0.05

Overall, the prevalence of orofacial trauma was approximately 41%. Its occurrence differed significantly between males and females, with approximately 40% of females and 60% of males with trauma experience. While there was no consistent gradient by age group, the 35-44 age group had the highest rate, and this differed significantly from the 18-24 and 75+ age groups, which had the lowest rates. The proportion with trauma experience was significant within each ethnic group. The Asian group had the lowest rate, while Māori had the highest. The prevalence in both the Māori and European/other group was higher than in the other two ethnic groups. A supplementary table is presented in Appendix VIII (Table 66). Data on when the orofacial trauma took place by sociodemographic characteristics are presented in Table 15.

Table 15. When orofacial trauma took place, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Within the last 12 months	More than one year but less than 2 years	More than 2 years but less than 3 years	More than 3 years but less than 5 years	More than 5 years[b]
Sex					
Female	4.6 (3.0, 6.9)	3.4 (1.6, 7.2)	5.1 (2.7, 9.5)	5.7 (3.3, 9.6)	81.2 (75.3, 85.9)
Male	9.3 (6.1, 14.1)	3.8 (1.9, 7.5)	2.3 (1.0, 4.9)	4.3 (2.1, 8.4)	80.3 (73.8 85.6)
Age group					
18-24	22.8 (10.6, 42.6)	15.1 (5.1, 37.2)	8.2 (2.2, 26.1)	2.0 (0.4, 10.0)	51.9 (32.1, 71.1)[a]
25-34	11.4 (5.6, 2.2)	4.9 (2.1, 11.0)	4.2 (1.4, 11.7)	9.0 (3.7, 20.1)	70.5 (56.5, 81.5)
35-44	5.0 (2.6, 9.5)	0.8 (0.4, 2.0)	3.8 (1.4, 9.6)	7.7 (4.0, 14.4)	82.6 (74.2, 88.7)
45-54	5.3 (2.3, 11.7)	4.0 (1.6, 9.6)	0.9 (0.3, 3.2)	3.1 (0.8, 11.5)	86.8 (79.0, 92.0)
55-64	3.5 (1.1, 10.5)	1.2 (0.3, 4.6)	3.1 (0.9, 9.9)	1.9 (0.3, 11.2)	90.3 (82.0, 95.0)
65-74	1.3 (0.2, 9.3)	0.6 (0.2, 2.7)	2.3 (0.4, 13.3)	1.3 (0.2, 9.1)	94.5 (85.8, 98.0)
75+	6.0 (1.6, 19.8)	1.7 (0.2, 12.6)	2.5 (0.3, 16.9)	0.0 (—)	89.8 (75.6, 96.2)
Ethnic group					
Māori	12.3 (8.5, 17.5)	5.0 (2.8, 8.8)	7.5 (4.1, 13.3)	6.2 (3.7, 10.1)	69.0 (62.4, 74.8)[a]
Pacific	7.0 (2.7, 16.9)	8.9 (2.7, 26.2)	1.8 (0.5, 6.0)	5.9 (1.6, 19.5)	76.3 (60.1, 87.3)
Asian	20.4 (8.2, 42.4)	0.5 (0.0, 3.4)	13.6 (3.7, 39.2)	4.5 (0.6, 27.9)	61.1 (39.9, 78.8)[a]
European/Other	6.0 (3.9, 9.3)	3.6 (2.0, 6.4)	2.5 (1.4, 4.4)	4.9 (3.0, 7.9)	83.0 (78.1, 87.0)[a]
Deprivation quintile					
1 (least deprived)	6.2 (2.5, 14.8)	2.5 (0.7, 8.8)	1.0 (0.2, 5.0)	4.0 (1.1, 13.2)	86.3 (76.3, 92.5)
2	9.5 (4.6, 18.6)	4.0 (1.2, 13.2)	3.1 (1.3, 7.0)	4.8 (1.7, 12.5)	78.6 (68.3, 86.2)
3	6.5 (2.9, 14.2)	1.7 (0.6, 4.9)	2.3 (0.9, 5.9)	6.1 (2.2, 16.0)	83.5 (74.8, 89.5)
4	3.4 (1.9, 5.9)	2.8 (1.3, 5.9)	8.3 (3.4, 19.2)	6.6 (2.7, 15.5)	78.9 (69.0, 86.2)
5 (most deprived)	11.2 (5.5, 21.5)	7.3 (3.1, 16.3)	2.6 (1.0, 6.6)	2.8 (1.2, 6.5)	76.1 (65.7, 84.0)
Highest education level					
Primary	5.2 (2.2, 11.8)	3.5 (1.3, 9.0)	1.7 (0.5, 5.9)	3.1 (1.1, 8.4)	86.6 (78.5, 91.9)
Secondary/vocational	7.9 (5.2, 11.8)	3.7 (1.9, 7.0)	2.9 (1.5, 5.3)	4.6 (2.6, 8.0)	81.1 (75.3, 85.8)
University	6.9 (3.0, 15.2)	3.7 (1.5, 8.4)	5.8 (2.2, 14.0)	6.4 (2.7, 14.2)	77.3 (65.3, 86.1)
All combined	7.4 (5.3, 10.4)	3.7 (2.2, 6.1)	3.4 (2.1, 5.5)	4.8 (3.1, 7.4)	80.7 (76.2, 84.5)

[a] $P<0.05$

[b] The 0-1% of respondents who 'did not know' were allocated to the 'more than 5 years' category

Approximately 80% of participants reported their orofacial trauma to have occurred more than five years previously. There was no sex difference. There was a higher occurrence of trauma within the last two years in the 18-24 age group than in the 35-44, 55-64 and 65-74 age groups. A smaller proportion had experienced trauma more than five years previously in the 18-24 group than the other age groups. A greater proportion in both the Māori and European/other groups experienced trauma more than five years ago. Higher proportions of the Asian group reported trauma occurring within the previous two years, or more than five years previously. Data on trauma to teeth by sociodemographic characteristics are presented in Table 16.

Table 16. Orofacial trauma including damage to teeth, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Teeth were damaged	
	Yes	No/Don't know/Refused
Sex		
Female	69.1 (61.4, 75.9)	30.9 (24.1, 38.6)
Male	69.0 (63.2, 74.3)	31.0 (25.7, 36.8)
Age group		
18-24	47.5 (29.6, 65.0)	52.6 (34.0, 70.4)[a]
25-34	59.8 (46.8, 71.6)	40.2 (28.4, 53.2)
35-44	72.7 (63.6, 80.2)	27.3 (19.8, 36.4)
45-54	74.5 (64.4, 82.4)	25.5 (17.6, 35.6)
55-64	69.5 (55.3, 80.8)	30.5 (19.2, 44.7)
65-74	79.2 (64.4, 88.9)	20.8 (11.1, 35.6)
75+	84.9 (65.6, 94.3)	15.1 (5.7, 34.4)
Ethnic group		
Māori	64.1 (57.9, 69.9)	35.9 (30.1, 42.1)
Pacific	60.7 (44.9, 74.5)	39.3 (25.5, 55.1)
Asian	61.1 (38.2, 80.0)	38.9 (20.0, 61.8)
European/Other	70.3 (64.9, 75.1)	29.7 (24.9, 35.1)
Deprivation quintile		
1 (least deprived)	74.2 (62.5, 83.3)	25.8 (16.7, 37.5)
2	67.5 (55.9, 77.3)	32.5 (22.8, 44.1)
3	68.1 (56.1, 78.1)	31.9 (21.9, 43.9)
4	69.9 (60.4, 77.9)	30.1 (22.1, 39.7)
5 (most deprived)	65.1 (56.2, 73.0)	34.9 (27.0, 43.8)
Highest education level		
Primary	74.0 (62.7, 82.8)	26.0 (17.2, 37.3)
Secondary/vocational	68.5 (62.6, 73.9)	31.5 (26.1, 37.4)
University	68.9 (57.8, 78.2)	31.1 (21.8, 42.2)
All combined	69.1 (64.3, 73.5)	31.0 (26.5, 35.7)

[a]P<0.05

Overall, approximately 70% of participants reported that the orofacial trauma had included damage to their teeth. There were no significant differences by sex, ethnic group, deprivation or education level. A greater proportion in the 75+ age group reported damage to teeth than the 18-24 age group. Supplementary tables are presented in Appendix VIII (Tables 65 and 66). Data on dental injury type are presented in Table 17.

Table 17. Type of injury to teeth by sociodemographic characteristics among those who reported dental trauma (data are row percentages unless otherwise indicated; brackets contain 95% CI)[b]

	Dental injury				
	Knocked but not displaced	Knocked and displaced	Knocked and superficially cracked	Knocked out	Chipped/broken
Sex					
Female	8.6 (5.0, 14.4)	8.8 (5.3, 14.5)	5.6 (3.1, 9.8)	7.4 (4.6, 11.7)	67.5 (59.8, 74.3)
Male	7.7 (4.1, 14.0)	10.1 (6.2, 16.1)	5.1 (2.6, 9.9)	10.9 (6.6, 17.4)	66.0 (57.7, 73.4)
Age group					
18-24	5.7 (0.7, 36.1)	13.5 (2.5, 49.0)	3.7 (0.6, 18.5)	12.2 (2.1, 47.6)	64.9 (33.4, 87.2)
25-34	6.5 (2.0, 19.3)	3.3 (0.5, 18.0)	6.3 (2.3, 15.8)	4.8 (1.6, 13.6)	76.3 (62.3, 86.2)
35-44	6.4 (2.4, 15.9)	8.2 (4.0, 16.3)	8.6 (3.7, 18.7)	7.2 (3.3, 14.7)	69.6 (57.6, 79.4)
45-54	12.7 (5.7, 25.8)	6.7 (2.6, 16.1)	0.7 (0.2, 2.9)	11.5 (5.3, 23.1)	68.4 (54.8, 79.4)
55-64	9.6 (3.4, 24.3)	12.8 (6.0, 25.1)	3.9 (1.2, 12.2)	9.5 (3.6, 22.9)	61.8 (46.7, 74.9)
65-74	1.2 (0.3, 5.4)	26.5 (13.9, 44.5)	9.1 (3.1, 24.0)	18.2 (7.3, 38.3)	43.8 (27.7, 61.2)
75+	12.7 (3.5, 36.8)	4.7 (0.7, 25.4)	3.9 (0.5, 25.7)	8.0 (2.8, 21.0)	68.8 (47.2, 84.5)
Ethnic group					
Māori	5.7 (3.3, 9.7)	11.1 (6.8, 17.7)	4.7 (2.5, 8.4)	16.0 (11.6, 21.7)	62.6 (55.2, 69.4)
Pacific	17.7 (4.8, 47.8)	2.8 (0.2, 28.4)	2.0 (0.2, 15.2)	13.9 (6.1, 28.9)	63.7 (38.2, 83.3)
Asian	6.7 (1.3, 28.1)	5.6 (2.0, 15.0)	5.1 (1.1, 20.8)	12.9 (1.7, 55.5)	69.7 (40.3, 88.7)
European/Other	8.0 (4.9, 12.7)	9.9 (6.7, 14.5)	5.3 (3.1, 8.8)	8.5 (5.5, 12.9)	67.2 (60.8, 73.1)
Deprivation quintile					
1 (least deprived)	4.1 (1.1, 14.2)	13.2 (6.3, 25.6)	1.3 (0.3, 5.1)	6.8 (2.0, 20.4)	74.7 (60.9, 84.8)
2	7.0 (2.5, 18.1)	11.1 (5.3, 21.9)	4.7 (1.7, 12.2)	10.2 (4.7, 20.6)	67.1 (55.4, 77.0)
3	3.8 (1.2, 11.2)	8.9 (3.7, 20.1)	7.9 (3.1, 19.1)	8.2 (3.4, 18.2)	66.1 (53.1, 77.0)
4	10.8 (4.5, 23.8)	6.3 (2.5, 14.9)	7.1 (2.9, 16.1)	13.4 (6.0, 27.3)	62.5 (48.6, 74.6)
5 (most deprived)	16.3 (7.8, 30.7)	6.9 (3.3, 13.6)	7.1 (2.1, 21.7)	9.3 (5.2, 16.1)	60.0 (45.6, 72.9)
Highest education level					
Primary	8.6 (3.4, 19.9)	7.1 (2.1, 21.3)	4.1 (1.1, 14.5)	13.3 (7.4, 22.8)	66.9 (52.0, 79.1)
Secondary/vocational	9.7 (5.9, 15.4)	10.9 (7.2, 16.3)	5.1 (3.0, 8.5)	8.8 (5.4, 14.11)	64.1 (56.4, 71.2)
University	2.8 (0.6, 12.1)	6.2 (2.4, 15.4)	6.4 (2.1, 17.9)	10.3 (4.5, 21.9)	74.3 (60.2, 84.7)
All combined	8.1 (5.2, 12.4)	9.6 (6.7, 13.6)	5.3 (3.3, 8.4)	9.5 (6.5, 13.7)	66.6 (60.6, 72.1)

[a]P<0.05

[b] 0.9% who "did not know" have been omitted from this table

There were no statistically significant differences in type of injury by sociodemographic characteristics. Approximately two-thirds of participants with dental trauma recalled teeth were “chipped or broken” (67%). Some 10% reported that their teeth had been “knocked out”. Data on care sought for dental injuries by sociodemographic characteristics are presented in Table 18.

Table 18. Care sought or received for injury to teeth by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Care sought for dental injury	
	Yes	No/Don't know
Sex		
Female	75.8 (68.5, 81.8)	24.2 (18.2, 31.5)
Male	70.9 (63.5, 77.4)	29.1 (22.6, 36.5)
Age group		
18-24	64.1 (34.8, 85.6)	35.9 (14.4, 65.2)
25-34	63.8 (45.7, 78.6)	36.2 (21.4, 54.3)
35-44	66.6 (55.6, 76.1)	33.4 (23.9, 44.4)
45-54	78.7 (68.7, 86.2)	21.3 (13.8, 31.3)
55-64	79.1 (63.4, 89.2)	20.9 (10.8 36.7)
65-74	83.8 (68.0, 92.6)	16.2 (7.4, 32.0)
75+	84.8 (54.6, 96.3)	15.2 (3.7, 45.4)
Ethnic group		
Māori	63.8 (55.4, 71.4)	36.2 (28.6, 44.6)[a]
Pacific	61.2 (34.8, 82.3)	38.8 (17.7, 65.2)
Asian	55.5 (31.3, 77.3)	44.5 (22.7, 68.7)
European/Other	75.0 (69.1, 80.0)	25.0 (20.0, 30.9)[a]
Deprivation quintile		
1 (least deprived)	81.0 (69.2, 89.0)	19.0 (11.0, 30.8)
2	77.5 (65.1, 86.4)	22.5 (13.6, 34.9)
3	70.9 (53.9, 83.6)	29.1 (16.4, 46.1)
4	66.4 (52.4, 78.0)	33.6 (22.1, 47.6)
5 (most deprived)	64.4 (50.6, 76.1)	35.6 (23.9, 49.4)
Highest education level		
Primary	63.3 (46.8, 77.1)	36.7 (22.9, 53.2)
Secondary/vocational	72.3 (65.3, 78.4)	27.7 (21.6, 34.7)
University	78.5 (66.8, 86.8)	21.5 (13.2, 33.2)
All combined	72.9 (67.5, 77.70	27.1 (22.3, 32.5)

[a]P<0.05

Overall, almost three quarters of participants sought or received treatment for their dental injury. The proportion who sought treatment was significantly higher within both Māori and European/other ethnic groups. There were no other differences that were statistically significant. Slightly more females than males pursued treatment. Three-quarters of participants from the European/other group sought or received treatment, and this was more than the ethnic minority groups. More older people had sought treatment, and there was a gradient by age group. Only just over half of Asian participants pursued care for their injury. People who were least deprived were more likely to have sought treatment, and the findings showed a consistent gradient. Similarly, participants with more than primary school education were more likely to have had treatment, and these findings showed a consistent gradient. Data on reasons for not seeking treatment by sociodemographic characteristics are presented in Table 19.

Table 19. Reason for not seeking care for injury to teeth, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Reason for not seeking care						
	Didn't know how to	Couldn't get an appointment	Didn't want to make a fuss	Couldn't be bothered	Cost too much	Didn't think it was serious enough	Lack of childcare
Sex							
Female	1.3 (0.2, 11.0)	0.6 (0.1, 4.5)	10.5 (4.3, 23.5)	3.9 (0.4, 27.2)	13.6 (5.6, 29.5)	55.4 (39.3, 70.5)	3.1 (0.4, 20.4)
Male	0.4 (0.1, 1.8)	3.5 (0.4, 23.9)	11.9 (5.1, 25.1)	7.6 (2.9, 18.8)	13.8 (6.4, 27.3)	47.9 (30.8, 65.6)	0.0 (—)
Age group							
18-24	5.5 (0.4, 42.8)	0.0 (—)	14.7 (2.3, 55.4)	11.7 (0.6, 73.1)	5.5 (0.7, 33.7)	58.1 (18.5, 89.4)	0.0 (—)
25-34	0.0 (—)	1.1 (0.1, 8.6)	16.3 (2.9, 56.1)	4.4 (1.2, 14.8)	13.2 (4.3, 33.8)	57.3 (30.9, 80.1)	0.0 (—)
35-44	0.0 (—)	6.4 (0.7, 38.6)	7.1 (2.4, 18.7)	8.6 (2.2, 28.6)	18.6 (7.7, 38.3)	40.8 (23.6, 60.5)	0.0 (—)
45-54	1.4 (0.3, 6.4)	0.0 (—)	7.0 (1.1, 32.7)	2.2 (0.5, 8.8)	21.5 (6.3 52.8)	61.6 (34.1, 83.3)	0.0 (—)
55-64	0.0 (—)	0.0 (—)	13.1 (1.3, 63.7)	1.2 (0.1, 9.2)	1.0 (0.1, 7.7)	74.3 (38.1, 93.1)	0.0 (—)
65-74	0.0 (—)	0.0 (—)	15.7 (2.4, 59.0)	15.1 (1.4, 69.4)	0.0 (—)	23.9 (2.5, 79.3)	19.8 (1.7, 78.0)
75+	0.0 (—)	0.0 (—)	37.5 (0.3, 99.1)	0.0 (—)	0.0 (—)	0.0 (—)	0.0 (—)
Ethnic group							
Māori	3.8 (0.7, 19.4)	1.4 (0.2, 9.8)	19.2 (10.1, 33.5)	8.7 (3.8, 18.9)	16.6 (8.3, 30.6)	37.7 (25.8, 51.3)	0.0 (—)
Pacific	2.7 (0.3, 22.0)	0.0 (—)	0.0 (—)	5.0 (0.5, 36.0)	22.0 (2.7, 74.3)	51.0 (15.6, 85.4)	0.0 (—)
Asian	0.0 (—)	0.0 (—)	8.7 (1.1, 44.6)	12.9 (1.0, 68.9)	4.7 (0.8, 24.0)	62.7 (25.8, 89.0)	0.0 (—)
European/Other	0.6 (0.1, 4.8)	2.8 (0.3, 19.3)	11.9 (5.8, 23.1)	6.4 (2.2, 17.3)	14.3 (7.8, 24.6)	48.9 (34.8, 63.2)	1.3 (0.2, 9.5)
Deprivation quintile							
1 (least deprived)	0.0 (—)	0.0 (—)	20.6 (3.6, 64.3)	0.7 (0.1, 5.7)	7.7 (0.8, 45.6)	57.1 (24.3, 84.6)	0.0 (—)
2	0.7 (0.1, 5.6)	0.0 (—)	0.6 (0.1, 5.3)	21.3 (5.6, 55.3)	16.5 (4.3, 46.4)	39.4 (13.9, 72.3)	5.4 (0.6, 33.7)
3	2.7 (0.3, 23.2)	0.0 (—)	6.0 (1.0, 28.1)	0.0 (—)	7.4 (1.6, 28.1)	70.7 (35.6, 91.3)	0.0 (—)
4	0.0 (—)	10.5 (1.3, 50.3)	17.8 (6.6, 39.9)	2.8 (0.8, 9.6)	10.5 (2.6, 34.0)	45.8 (22.2, 71.5)	0.0 (—)
5 (most deprived)	0.6 (0.1, 4.3)	0.0 (—)	11.9 (4.3, 29.0)	5.6 (1.2, 22.3)	24.0 (11.1, 44.5)	45.0 (25.1, 66.7)	0.0 (—)
Highest education level							
Primary	1.1 (0.1, 8.5)	1.9 (0.2, 13.9)	12.2 (3.4, 35.3)	2.7 (0.6, 11.9)	5.1 (1.5, 15.9)	56.4 (29.1, 80.3)	0.0 (—)
Secondary/vocational	0.9 (0.2, 4.7)	3.2 (0.4, 21.8)	12.6 (6.0, 24.7)	7.6 (2.7, 19.7)	15.9 (8.7, 27.4)	48.9 (33.3, 64.8)	1.5 (0.2, 10.9)
University	0.0 (—)	0.0 (—)	5.8 (0.7, 35.5)	3.2 (0.5, 16.9)	10.3 (2.4, 34.6)	53.7 (26.4, 79.0)	0.0 (—)
All combined	0.7 (0.2, 3.2)	2.5 (0.4, 15.1)	11.4 (6.0, 20.5)	6.3 (2.6, 14.5)	13.7 (8.1, 22.3)	50.6 (38.3, 62.8)	1.1 (0.1, 7.9)

[a]P<0.05

Table 19. (continued)

	Couldn't get in touch with the dental professional	Couldn't spare the time	Anxiety or fear of dental treatment	ACC paperwork too complicated	Don't know
Sex					
Female	0.2 (0.0, 1.5)	0.2 (0.0, 1.5)	2.0 (0.5, 7.5)	0.0 (—)	9.1 (4.2, 18.6)
Male	3.6 (0.9, 13.7)	0.8 (0.2, 3.2)	0.7 (0.2, 3.1)	0.7 (0.1, 5.3)	9.1 (3.4, 21.8)
Age group					
18-24	0.0 (—)	0.0 (—)	4.4 (0.5, 31.9)	0.0 (—)	0.0 (—)
25-34	0.0 (—)	0.0 (—)	0.0 (—)	0.0 (—)	7.8 (2.0, 25.6)[a]
35-44	6.5 (1.5, 24.2)	0.3 (0.0, 2.1)	0.7 (0.1, 5.2)	0.0 (—)	11.0 (3.4, 30.7)
45-54	0.0 (—)	0.4 (0.1, 3.0)	1.5 (0.3, 7.3)	2.4 (0.3, 17.8)	2.0 (0.6, 6.3)
55-64	0.8 (0.1, 6.1)	0.0 (—)	2.9 (0.3, 21.2)	0.0 (—)	6.8 (1.0, 33.2)
65-74	0.0 (—)	6.0 (0.6, 40.2)	0.0 (—)	0.0 (—)	19.5 (3.4, 62.7)
75+	0.0 (—)	3.5 (0.1, 60.1)	0.0 (—)	0.0 (—)	58.9 (0.7, 99.7)
Ethnic group					
Māori	0.5 (0.1, 3.3)	1.1 (0.3, 4.3)	7.5 (2.8, 18.4)	0.0 (—)	3.6 (1.4, 8.9)[a]
Pacific	0.0 (—)	0.0 (—)	1.6 (0.2, 13.8)	0.0 (—)	17.7 (1.6, 74.2)
Asian	0.0 (—)	1.0 (0.1, 8.0)	0.0 (—)	0.0 (—)	10.0 (2.7, 31.0)
European/Other	2.9 (0.7, 10.6)	0.6 (0.1, 2.5)	0.3 (0.0, 2.3)	0.6 (0.1, 4.1)	9.4 (4.2, 19.8)
Deprivation quintile					
1 (least deprived)	0.0 (—)	0.0 (—)	0.0 (—)	0.0 (—)	13.8 (2.9, 46.2)[a]
2	11.3 (2.8, 36.4)	1.6 (0.2, 12.5)	0.0 (—)	0.0 (—)	3.0 (0.5, 17.4)
3	0.4 (0.0, 3.4)	0.5 (0.1, 4.6)	0.4 (0.0, 3.9)	2.5 (0.3, 19.7)	9.3 (1.1, 48.2)
4	0.0 (—)	0.0 (—)	3.5 (1.0, 11.6)	0.0 (—)	9.1 (1.8, 34.7)
5 (most deprived)	0.0 (—)	0.8 (0.2, 3.4)	1.2 (0.2, 9.3)	0.0 (—)	10.9 (3.7, 28.1)
Highest education level					
Primary	0.0 (—)	0.8 (0.1, 6.6)	2.4 (0.3, 17.3)	3.9 (0.5, 26.7)	13.5 (1.5, 61.3)
Secondary/vocational	1.3 (0.2, 8.0)	0.7 (0.2, 2.9)	0.8 (0.2, 3.8)	0.0 (—)	6.5 (2.8, 14.4)
University	8.3 (0.9, 46.5)	0.0 (—)	1.9 (0.3, 10.1)	0.0 (—)	16.8 (4.3, 47.7)
All combined	2.4 (0.6, 8.8)	0.6 (0.2, 2.1)	1.2 (0.4, 3.2)	0.5 (0.1, 3.4)	9.1 (4.5, 17.3)

[a]P<0.05

Just over half of the participants had decided not to pursue treatment for their dental injury because they did not think the injury was serious enough. The next reason, given by one in seven, was treatment costing too much. Overall, just over 1% of people reported that anxiety or fear of dental treatment prevented them from seeking treatment for their injury. Significantly more Māori than European/other reported fear or anxiety to be the reason for not obtaining treatment. Data on discussion of treatment options by a health professional by sociodemographic characteristics are presented in Table 20.

Table 20. Discussion of treatment options by health professional for injury to teeth, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Discussion took place					
	Always	Often	Sometimes	Occasionally	Never	Don't know
Sex						
Female	54.4 (42.8, 65.6)	5.4 (2.6, 11.0)	2.2 (0.6, 7.5)	0.9 (0.2, 4.0)	8.1 (4.3, 14.8)	29.0 (19.2, 41.2)
Male	60.7 (51.2, 69.4)	5.2 (2.2, 11.6)	1.6 (0.5, 4.7)	3.0 (0.9, 9.3)	12.0 (6.7, 20.3)	12.0 (6.7, 20.3)
Age group						
18-24	79.1 (33.9, 96.5)	0.8 (0.1, 7.2)	0.0 (—)	14.8 (1.3, 69.5)	0.9 (0.1, 7.9)	4.4 (0.1 59.4)
25-34	55.5 (37.1, 72.4)	1.1 (0.1, 8.3)	0.0 (—)	2.1 (0.5, 8.2)	15.7 (6.0, 35.1)	25.6 (11.8, 46.9)
35-44	53.4 (37.3, 68.8)	4.3 (1.3, 13.8)	1.7 (0.2, 2.1)	0.3 (0.0, 2.1)	10.6 (3.8, 26.1)	29.8 (17.9, 45.2)
45-54	56.7 (42.3, 69.9)	6.1 (1.7, 20.2)	2.1 (0.6, 6.7)	1.3 (0.3, 6.2)	11.0 (3.8, 27.7)	22.8 (12.9, 37.1)
55-64	51.3 (33.8, 68.5)	9.6 (2.9, 27.0)	0.0 (—)	2.7 (0.4, 16.5)	15.8 (4.9, 40.7)	20.6 (9.6, 38.8)
65-74	69,0 (50.7, 82.7)	8.8 (2.4, 27.8)	4.2 (0.9, 18.6)	2.1 (0.3, 15.2)	0.4 (0.0, 2.9)	15.5 (6.5, 32.7)
75+	65.8 (41.9, 83.7)	3.1 (0.4, 20.8)	7.3 (0.8, 42.2)	0.0 (—)	9.8 (2.2, 34.6)	14.0 (4.5, 35.7)
Ethnic group						
Māori	59.9 (50.5, 68.6)	3.3 (1.4, 7.5)	2.5 (0.6, 9.6)	2.6 (0.7, 9.4)	18.7 (12.7, 26.7)	13.0 (7.8, 20.9)
Pacific	56.2 (25.5, 82.7)	4.8 (0.5, 32.4)	0.0 (—)	6.1 (1.2, 26.1)	13.9 (2.9, 46.3)	19.0 (6.0, 46.5)
Asian	48.8 (18.0, 80.5)	0.8 (0.1, 6.0)	2.6 (0.3, 19.3)	20.4 (1.8, 78.3)	8.7 (0.5, 62.3)	18.8 (5.8, 46.8)[a]
European/Other	58.0 (49.7, 65.8)	5.6 (3.1, 9.8)	1.7 (0.7, 4.3)	1.2 (0.5, 3.1)	10.2 (6.2, 16.4)	23.3 (17.0, 31.1)[a]
Deprivation quintile						
1 (least deprived)	52.4 (35.9, 68.4)	6.5 (1.9, 19.8)	1.6 (0.2, 11.2)	1.2 (0.2, 5.5)	10.3 (4.1, 23.8)	28.0 (16.6, 43.1)
2	69.9 (53.5, 82.5)	4.5 (1.4, 13.4)	0.0 (—)	1.6 (0.3, 8.4)	8.0 (2.6, 22.3)	16.0 (6.8, 33.2)
3	59.5 (44.8, 72.7)	8.8 (3.2, 22.2)	3.5 (0.6, 16.8)	0.9 (0.1, 7.8)	9.4 (3.3, 24.1)	17.9 (9.6, 30.9)
4	40.8 (26.8 56.6)	5.0 (1.0, 21.0)	2.6 (0.5, 12.3)	5.1 (0.6, 32.1)	18.1 (8.0, 36.2)	28.3 (15.44, 46.1)
5 (most deprived)	65.7 (48.6, 79.5)	0.8 (0.2, 2.8)	2.8 (0.6, 11.8)	2.6 (0.6, 11.1)	6.4 (2.0, 18.8)	21.7 (10.6, 39.3)
Highest education level						
Primary	71.9 (53.0, 85.3)	0.0 (—)	3.6 (0.9, 13.8)	1.4 (0.3, 6.7)	6.3 (2.0, 18.0)	16.9 (7.0, 35.4)
Secondary/vocational	57.4 (47.5, 66.6)	6.0 (3.1, 11.4)	1.9 (0.6, 5.4)	2.9 (1.0, 8.0)	8.3 (4.6, 14.3)	23.5 (16.3, 32.7)
University	55.7 (39.6, 70.8)	4.7 (1.5, 13.3)	1.2 (0.2, 8.3)	0.0 (—)	17.8 (7.9, 35.5)	20.6 (11.5, 34.3)
All combined	58.0 (50.2, 65.5)	5.3 (3.0, 9.1)	1.8 (0.8, 4.1)	2.1 (0.8, 5.6)	10.3 (6.6, 15.9)	22.4 (16.5, 29.6)

[a]P<0.0

Of those who received treatment for their dental injury, more than half recalled that discussion of treatment options had "always" occurred. Only 10% reported that this did not occur. Almost 50% of Asian and almost 60% of European/other participants reported a discussion about treatment options, and these differences were statistically significant. There were no other statistically significant differences. Females were slightly less likely to have recalled a discussion than males, and people in the 18-24 age group were more likely to have had a discussion than people who were older. People who had a university qualification were less likely than people with only secondary or primary education to have had a discussion about treatment options. Data on the function of damaged teeth after they were repaired by sociodemographic characteristics are presented in Table 21.

Table 21. Function of damaged teeth after repair, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Function			
	Better than before accident	About the same as before the accident	Worse than before the accident	Don't know/Refused
Sex				
Female	7.3 (3.3, 15.1)	65.9 (56.8, 73.9)	19.4 (13.4, 27.3)	7.5 (4.1, 13.4)
Male	3.4 (1.3, 8.6)	66.5 (56.9, 74.9)	26.7 (18.7, 36.6)	3.4 (1.4, 7.9)
Age group				
18-24	16.7 (1.8, 68.9)	46.2 (13.7, 82.3)	33.2 (6.2, 78.8)	3.9 (0.1, 65.8)
25-34	3.8 (1.3, 10.5)	78.2 (61.9, 88.8)	13.0 (5.7, 27.0)	5.0 (1.7, 14.1)
35-44	0.5 (0.1, 1.6)	70.4 (57.1, 80.9)	24.3 (14.5, 37.8)	4.9 (1.6, 13.9)
45-54	5.5 (1.4, 18.9)	60.9 (45.3, 74.5)	28.9 (16.4, 45.8)	4.7 (1.5, 13.8)
55-64	4.0 (0.8, 18.2)	74.0 (58.1, 85.4)	16.4 (7.4, 32.8)	5.6 (1.6, 17.8)
65-74	11.2 (3.6, 29.7)	49.9 (29.7, 70.0)	29.5 (14.0, 51.8)	9.4 (3.5, 23.0)
75+	5.2 (0.6, 32.9)	77.7 (56.4, 90.3)	17.1 (6.9, 36.5)	0.0 (—)
Ethnic group				
Māori	11.9 (7.2, 19.1)	49.8 (41.1, 58.5)	29.4 (22.4, 37.5)	8.9 (4.8, 16.1)
Pacific	4.3 (0.8, 20.8)	66.7 (35.6, 87.8)	26.8 (8.7, 58.5)	2.2 (0.2, 18.9)
Asian	2.6 (0.5, 13.5)	52.7 (21.7, 81.8)	37.8 (10.1, 76.6)	6.9 (0.4, 59.8)
European/Other	4.8 (2.4, 9.1)	68.0 (61.0, 74.3)	22.2 (16.5, 29.3)	45.0 (2.9, 8.5)
Deprivation quintile				
1 (least deprived)	5.9 (1.6, 19.1)	61.2 (45.4, 75.0)	27.5 (16.1, 42.8)	5.5 (1.6, 17.0)
2	2.7 (0.8, 8.4)	69.6 (55.1, 81.0)	27.1 (15.9, 42.1)	0.7 (0.1, 3.7)
3	7.4 (2.5, 20.2)	70.6 (55.2, 82.3)	19.4 (10.2, 33.7)	2.7 (1.0, 7.0)
4	2.2 (0.9, 5.2)	62.5 (44.7, 77.5)	23.6 (11.2, 43.0)	11.7 (4.9, 25.5)
5 (most deprived)	8.2 (1.7, 31.3)	68.7 (52.3, 81.5)	15.8 (9.3, 25.8)	7.2 (3.0, 16.2)
Highest education level				
Primary	0.0 (—)	63.8 (44.5, 79.5)	24.2 (12.8, 40.8)	12.0 (4.1, 30.3)
Secondary/vocational	6.9 (3.7, 12.4)	65.4 (57.3, 72.6)	22.8 (16.3, 30.9)	5.0 (2.6, 9.3)
University	1.0 (0.4, 2.6)	69.6 (54.0, 81.7)	26.1 (14.5, 42.3)	3.3 (1.0, 10.8)
All combined	5.0 (2.8, 8.9)	66.2 (59.5, 72.3)	23.7 (18.0, 30.5)	5.1 (3.1, 8.2)

[a]P<0.05

Overall, about two-thirds of participants felt that their damaged teeth functioned about the same as before the trauma, once they had been repaired. Almost one quarter reported that function was worse than before the accident. Almost half of Māori people thought that function was about the same after repair, while almost one-third thought function was worse after repair, and this was statistically significant. Although the difference was not significant, a greater proportion of Asian people thought that function was worse after repair, than other ethnic groups. European/other had the smallest proportion by ethnicity that found that function was worse after repair. People who were most deprived were less likely to have found function worse after repair. Data on the appearance of damaged teeth after they were repaired by sociodemographic characteristics are presented in Table 22.

Table 22. Appearance of damaged teeth after repair or replacement, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Appearance			
	Better than before the accident	About the same as before the accident	Worse than before the accident	Don't know/Refused
Sex				
Female	10.3 (5.6, 18.4)	54.3 (43.6, 64.5)	29.6 (21.0, 39.9)	5.8 (2.7, 12.0)
Male	8.2 (4.3, 15.1)	62.6 (52.2, 72.0)	26.1 (18.1, 36.0)	2.9 (1.0, 7.6)
Age group				
18-24	18.1 (2.3, 67.5)	24.9 (5.0, 67.8)	53.1 (16.0, 87.1)	3.9 (0.1, 65.8)
25-34	8.9 (2.6, 26.3)	68.4 (49.8, 82.6)	13.9 (6.5, 27.4)	8.7 (2.4, 26.8)
35-44	5.6 (2.0, 14.6)	55.0 (40.5, 68.7)	34.7 (22.2, 49.8)	4.7 (1.5, 13.9)
45-54	13.7 (6.3, 27.3)	49.7 (36.8, 62.6)	33.8 (21.8, 48.4)	2.8 (0.6, 12.3)
55-64	10.6 (4.3, 23.6)	73.0 (58.1, 84.1)	13.5 (5.8, 28.4)	2.9 (0.6, 13.5)
65-74	4.2 (1.3, 12.5)	73.8 (57.1, 85.6)	17.1 (7.7, 33.7)	4.9 (1.2, 17.6)
75+	1.3 (0.1, 10.8)	75.1 (53.1, 88.9)	23.6 (10.2, 45.9)	0.0 (—)
Ethnic group				
Māori	18.6 (12.2, 27.3)	42.5 (33.3, 52.2)	30.5 (21.1, 41.8)	8.5 (4.5, 15.4)
Pacific	8.1 (2.1, 26.9)	76.2 (52.6, 90.2)	13.5 (4.2, 35.8)	2.2 (0.2, 18.9)
Asian	7.3 (2.0, 23.1)	44.7 (20.5, 71.7)	42.7 (14.7, 76.3)	5.3 (0.1, 70.4)
European/Other	8.5 (5.0, 14.3)	60.5 (52.4, 68.0)	26.9 (20.3, 34.7)	4.1 (2.1, 7.7)
Deprivation quintile				
1 (least deprived)	4.9 (1.9, 11.6)	58.7 (43.8, 72.2)	32.3 (20.3, 47.2)	4.2 (1.0, 16.0)
2	9.1 (3.3, 22.9)	65.9 (49.1, 79.5)	24.8 (13.2, 41.7)	0.2 (0.0, 1.2)
3	4.8 (1.4, 14.9)	64.5 (48.2, 78.0)	28.3 (16.0, 44.9)	2.1 (0.7, 6.5)
4	7.9 (3.7, 16.2)	52.4 (35.0, 69.2)	28.8 (15.5, 47.1)	10.3 (3.7, 25.5)
5 (most deprived)	22.4 (10.1, 42.8)	50.2 (33.6, 66.7)	21.9 (12.8, 34.9)	5.5 (1.8, 15.3)
Highest education level				
Primary	16.6 (3.9, 49.1)	46.2 (28.3, 65.1)	25.5 (13.4, 43.0)	10.2 (2.9, 29.6)
Secondary/vocational	10.3 (5.9, 17.2)	60.1 (51.0, 68.5)	25.3 (18.3, 33.9)	4.3 (2.0, 9.0)
University	3.2 (1.1, 9.0)	60.3 (44.4, 74.3)	35.0 (21.4, 51.5)	1.5 (0.3, 6.8)
All combined	9.1 (5.7, 14.2)	59.1 (51.8, 66.1)	27.6 (21.3, 34.8)	4.2 (2.4, 7.4)

P<0.05

Overall, almost 60% of participants reported the appearance of their injured teeth after repair was about the same as before the injury. Just over a quarter reported appearance to be worse. Only just over 40% over Māori reported appearance to be similar after repair, and almost a third reported appearance was worse. There were no further statistically significant findings. More females reported appearance to be worse. Over half of people aged 18-24 found appearance to be worse. The Asian group had the largest proportion of people who found the appearance worse after repair, at just over 40%. There was a consistent gradient with deprivation, with those more deprived less likely to report appearance worse after repair. Those with only primary education were less likely to have reported appearance to be similar after injury than other education levels, while those with a university education had a higher proportion who felt appearance was worse. Data on the current state of repaired or replaced teeth by sociodemographic characteristics are presented in Table 23.

Table 23. Current state of repaired or replaced teeth, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Repaired or replaced teeth in good order		
	Yes	No	Don't know/Refused
Sex			
Female	59.6 (49.6, 68.9)	33.6 (25.2, 43.3)	6.8 (2.9, 15.1)
Male	55.6 (46.6, 64.3)	42.1 (33.6, 51.1)	2.3 (0.9, 5.7)
Age group			
18-24	49.0 (16.4, 82.5)	31.4 (6.5, 75.1)	19.6 (2.4, 70.6)
25-34	59.0 (38.8, 76.6)	36.5 (20.1, 56.7)	4.5 (1.4, 13.7)
35-44	56.9 (42.0, 70.6)	39.2 (25.7, 54.6)	3.9 (1.3, 11.1)
45-54	49.1 (33.4, 65.0)	48.1 (32.3, 64.2)	2.8 (0.6, 12.3)
55-64	73.0 (54.5, 85.9)	25.7 (13.2, 44.1)	1.3 (0.3, 4.6)
65-74	58.6 (39.5, 75.5)	36.8 (20.4, 56.9)	4.6 (1.2, 16.6)
75+	61.2 (36.7, 81.1)	38.8 (18.9, 63.3)	0.0 (—)
Ethnic group			
Māori	45.7 (36.1, 55.6)	45.8 (36.7, 55.1)	8.5 (4.8, 14.7)
Pacific	33.0 (13.8, 60.4)	61.7 (34.3, 83.2)	5.3 (1.0, 23.1)
Asian	54.7 (22.9, 83.1)	39.9 (11.3, 77.6)	5.3 (0.1, 70.4)
European/Other	58.1 (50.4, 65.4)	37.9 (30.9, 45.4)	4.0 (2.0, 8.1))
Deprivation quintile			
1 (least deprived)	59.5 (43.4, 73.8)	30.7 (18.1, 47.0)	9.8 (3.5, 24.3)
2	54.3 (38.6, 69.1)	45.6 (30.8, 61.3)	0.1 (0.0, 0.8)
3	55.5 (41.0, 69.2)	42.1 (28.9, 56.7)	2.3 (0.8, 6.5)
4	60.1 (43.7, 74.6)	37.5 (23.3, 54.3)	2.3 (0.8, 6.6)
5 (most deprived)	57.4 (40.4, 72.7)	37.1 (22.5, 54.6)	5.5 (2.0, 14.6)
Highest education level			
Primary	33.7 (18.8, 52.9)	53.0 (34.0, 71.2)	13.3 (4.9, 31.2)
Secondary/vocational	59.0 (51.0, 66.6)	37.1 (29.8, 45.0)	3.9 (1.5, 9.4)
University	59.6 (42.6, 74.5)	38.3 (23.4, 55.9)	2.1 (0.6, 7.2)
All combined	57.3 (50.2, 64.1)	38.6 (32.1, 45.5)	4.1 (2.2, 7.7)

[a]P<0.05

Almost 60% of participants reported that their repaired teeth were currently in good order. Only one-third of people with only primary school education felt this was the case, but this difference was not statistically significant. Similarly, only one-third of Pacific people felt that their repaired teeth were currently in good order, but this was not significant. Data on whether original treatment was checked by a dental professional by sociodemographic characteristics are presented in Table 24.

Table 24. Original dental repair or replacement checked by a dental professional, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Original treatment checked		
	Yes	No	Don't know
Sex			
Female	68.6 (58.0, 77.5)	29.6 (21.0, 40.0)	1.8 (0.4, 7.3)
Male	71.3 (61.8, 79.2)	28.3 (20.4, 37.8)	0.4 (0.1, 1.4)
Age group			
18-24	71.5 (31.8, 93.1)	24.6 (5.0, 66.9)	3.9 (0.1, 65.8)
25-34	61.2 (35.3, 82.0)	38.0 (17.3, 64.2)	0.8 (0.2, 4.1)
35-44	69.7 (56.1, 80.5)	28.8 (18.2, 42.4)	1.5 (0.3, 7.5)
45-54	60.1 (43.9, 74.3)	39.2 (25.2, 55.3)	0.7 (0.2, 2.7)
55-64	85.1 (70.1, 93.3)	14.2 (6.2, 29.4)	0.6 (0.1, 2.9)
65-74	82.1 (65.9, 91.6)	17.9 (8.4, 34.1)	0.0 (—)
75+	79.1 (60.0, 90.5)	20.9 (9.5, 40.0)	0.0 (—)
Ethnic group			
Māori	45.3 (36.7, 54.2)	50.4 (41.6, 59.3)	4.3 (2.0, 8.9)
Pacific	59.9 (29.6, 84.1)	40.1 (15.9, 70.4)	0.0 (—)
Asian	68.3 (32.4, 90.6)	26.4 (9.7, 54.4)	5.3 (0.1, 70.4)
European/Other	72.2 (64.7, 78.6)	26.7 (20.3, 34.4)	1.0 (0.3, 3.3)
Deprivation quintile			
1 (least deprived)	66.2 (51.6, 78.3)	31.7 (199.8, 46.4)	2.1 (0.3, 13.5)
2	70.8 (55.8, 82.3)	29.1 (17.6, 44.1)	0.1 (0.0, 0.8)
3	70.6 (53.1, 83.5)	28.9 (16.0, 46.4)	0.6 (0.2, 1.9)
4	76.9 (58.9, 88.6)	22.1 (10.6, 40.5)	0.9 (0.2, 4.6)
5 (most deprived)	67.5 (51.4, 80.3)	31.4 (18.8, 47.6)	1.1 (0.3, 3.8)
Highest education level			
Primary	47.2 (28.6, 66.5)	46.6 (27.5, 66.8)	6.2 (1.3, 24.7)
Secondary/vocational	73.8 (65.6, 80.7)	25.5 (18.7, 33.9)	0.6 (0.1, 4.3)
University	66.5 (49.8, 80.0)	33.1 (19.7, 49.8)	0.4 (0.1, 1.7)
All combined	70.2 (63.4, 76.2)	28.8 (22.8, 35.7)	1.0 (0.3, 3.0)

[a]P<0.05

Overall, more than two-thirds of participants reported that a dental professional had checked the repair since it was originally done. Only 45% of Māori people believed this to be the case. Similarly, a significantly smaller proportion of participants with only primary school education reported that the original repair had been checked. Data on ACC assistance for dental treatment by sociodemographic characteristics are presented in Table 25.

Table 25. ACC assistance for payment for treatment of last dental injury, by sociodemographic characteristics (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	ACC helped pay for treatment		
	Yes	No	Don't know/refused
Sex			
Female	40.2 (30.3, 51.0)	44.8 (33.9, 56.2)	15.0 (7.6, 27.2)
Male	40.1 (31.3, 49.7)	48.5 (38.5, 58.6)	11.4 (6.0, 20.6)
Age group			
18-24	60.9 (19.9, 90.8)	18.9 (2.6, 67.1)	20.1 (2.6, 70.4)
25-34	48.7 (26.2, 71.7)	31.4 (15.4, 53.5)	19.9 (5.2, 53.3)
35-44	49.6 (35.2, 64.0)	32.2 (21.0, 45.9)	18.2 (9.0, 33.2)
45-54	30.0 (17.4, 46.4)	59.4 (42.5, 74.3)	10.7 (3.7, 27.1)
55-64	47.0 (31.3, 63.3)	47.4 (29.1, 66.5)	5.6 (0.7, 33.7)
65-74	18.3 (8.7, 34.3)	73.4 (51.3, 87.9)	8.3 (1.0, 44.4)
75+	26.4 (13.1, 45.9)	73.6 (54.1, 86.9)	0.0 (—)
Ethnic group			
Māori	49.4 (37.9, 61.0)	43.0 (32.7, 54.0)	7.5 (3.6, 15.2)
Pacific	50.9 (24.0, 77.3)	43.0 (18.8, 71.0)	6.1 (1.2, 26.1)
Asian	39.4 (12.7, 74.4)	52.4 (22.2, 80.9)	8.2 (0.9, 48.1)
European/Other	39.7 (32.6, 47.3)	46.6 (38.0, 55.5)	13.7 (8.4, 21.5)
Deprivation quintile			
1 (least deprived)	35.9 (22.5, 51.9)	46.9 (32.8, 61.5)	17.2 (7.6, 34.3)
2	37.6 (23.9, 53.6)	50.4 (35.2, 65.6)	12.0 (4.5, 28.0)
3	27.5 (16.3, 42.6)	59.4 (43.3, 73.7)	13.1 (4.4, 32.8)
4	51.7 (34.4, 68.6)	34.6 (21.2, 51.0)	13.7 (4.7, 33.9)
5 (most deprived)	52.3 (35.2, 68.9)	41.9 (26.3, 59.4)	5.8 (2.0, 15.8)
Highest education level			
Primary	44.8 (26.4, 64.8)	49.5 (30.9, 68.1)	5.7 (1.1, 24.6)
Secondary/vocational	41.9 (33.7, 50.5)	45.3 (35.7, 55.2)	12.8 (7.0, 22.3)
University	33.6 (20.4, 49.8)	51.2 (35.2, 66.9)	15.3 (6.2, 32.9)
All combined	40.2 (33.6, 47.1)	47.0 (39.0, 55.1)	12.9 (8.0, 20.0)

[a]P<0.05

Four out of ten participants reported that the ACC had helped pay for the dental treatment, while almost half reported no ACC help. There were no statistically significant findings. Older people were much less likely to have had ACC help pay for treatment. People with a university education were less likely than people with only primary or secondary education to have reported ACC assistance. Data on knowledge of ACC cover for dental trauma by sociodemographic characteristics are presented in Table 26.

Table 26. Knowledge of ACC cover for trauma to mouth and teeth (data are row percentages unless otherwise indicated; brackets contain 95% CI)

	Can the ACC help pay for treatment?		
	Yes	No	Not sure/don't know/refused
Sex			
Female	56.6 (52.7, 60.5)	6.4 (4.8, 8.5)	37.0 (33.3, 40.8)
Male	58.1 (53.9, 62.2)	4.4 (2.8, 6.9)	37.5 (33.6, 41.6)
Ethnicity			
Māori	46.4 (41.4, 51.9)	3.6 (25, 5.2)	49.9 (44.4, 55.4)[a]
Pacific	34.5 (28.0, 41.6)	6.3 (3.6, 10.8)	59.2 (51.4, 66.5)[a]
Asian	28.8 (21.6, 37.4)	7.9 (4.3, 14.2)	63.2 (54.1, 71.6)[a]
European/other	62.7 (59.2, 66.2)	5.2 (3.9, 7.0)	32.0 (28.8, 35.4)[a]
Age group			
18-24	36.2 (26.6, 47.1)	5.8 (2.5, 12.8)	58.0 (47.8, 67.5)[a]
25-34	49.4 (40.8, 58.1)	5.0 (2.6, 9.4)	45.6 (36.8, 54.7)
35-44	65.0 (58.9, 70.7)	4.4 (2.4, 7.9)	30.5 (25.2, 36.4)
45-54	66.8 (60.2, 72.7)	4.7 (2.6, 8.4)	28.5 (23.1, 34.7)
55-64	65.9 (58.3, 72.8)	5.6 (2.8, 11.2)	28.5 (22.7, 35.1)
65-74	63.5 (53.8, 72.1)	6.4 (3.0, 13.3)	30.1 (22.7, 38.8)
75+	35.8 (27.2, 45.5)	11.1 (6.0, 19.4)	53.1 (42.5, 63.4)
Deprivation quintile			
1 (least deprived)	64.8 (57.0, 71.8)	5.6 (3.2, 9.5)	29.6 (23.0, 37.3)
2	58.6 (51.7, 65.2)	6.1 (3.6, 10.0)	35.3 (29.1, 42.2)
3	55.2 (49.0, 61.2)	3.9 (2.1, 7.0)	40.9 (35.1, 47.0)
4	57.0 (50.3, 63.5)	6.1 (3.5, 10.5)	36.8 (30.2, 44.0)
5 (most deprived)	49.5 (42.8, 56.2	5.5 (3.1, 9.4)	45.1 (38.1, 52.2)
Highest education level			
Primary	50.1 (42.1, 58.2)	8.3 (4.8, 13.9)	41.6 (33.5, 50.2)
Secondary/vocational	57.2 (53.2, 61.0)	5.7 (4.2, 7.7)	37.1 (33.6, 40.8)
University	61.1 (54.5, 67.2)	3.4 (1.8, 6.3)	35.5 (29.4, 42.2)
All combined	57.3 (54.5, 60.1)	5.5 (4.2, 7.1)	37.2 (34.6, 39.9)

[a]P<0.05

Just over half of the participants thought that ACC could help pay for treatment for injuries to the mouth and teeth. Just over two-thirds did not know or were not sure, and the remainder thought ACC would not pay for treatment. There was no sex difference. Considerably more people in the European/other group than the other ethnic groups thought the ACC would help pay. Significantly fewer people in the youngest and oldest age groups thought the ACC would pay for treatment than people aged 35-74 years. Although not significant, there was a consistent gradient with education, with more educated people more likely to be aware of ACC payment for treatment. Data on participation in contact sports by sociodemographic characteristics are presented in Table 27.

Table 27. Participation in contact sport by sociodemographic characteristics (data are row percentages; brackets contain 95% CI)

	Play contact sport	
	Yes	No
Sex		
Female	5.8 (4.1, 8.2)	94.2 (91.8, 95.9)[a]
Male	11.5 (8.8, 14.8)	88.5 (85.2, 91.2)
Age group		
18-24	21.1 (13.1, 32.30	78.9 (67.7, 86.9)[a]
25-34	16.5 (11.0, 24.1)	83.5 (75.9, 89.0)
35-44	8.0 (5.3, 11.9)	92.0 (88.1, 94.7)
45-54	5.0 (2.7, 9.1)	95.0 (90.9, 97.3)
55-64	0.8 (0.2, 2.8)	99.2 (97.2, 99.8)
65-74	0.0 (—)	0.0 (—)
75+	0.0 (—)	0.0 (—)
Ethnic group		
Māori	14.4 (10.8, 18.9)	85.6 (81.1, 89.2)[a]
Pacific	13.5 (8.2, 21.6)	86.5 (78.4, 91.8)
Asian	14.8 (8.0, 25.9)	85.2 (74.1, 92.0)
European/Other	7.1 (5.3, 9.5)	92.9 (90.5, 94.7)[a]
Deprivation quintile		
1 (least deprived)	3.8 (1.8, 8.1)	96.2 (91.9, 98.2)
2	7.6 (4.5, 12.6)	92.4 (87.4, 95.5)
3	12.4 (8.1, 18.5)	87.6 (81.5, 91.9)
4	9.1 (5.8, 14.0)	90.9 (86.0, 94.2)
5 (most deprived)	10.2 (6.2, 16.3)	89.8 (83.7, 93.8)
Highest education level		
Primary	2.2 (1.1, 4.4)	97.8 (95.6, 98.9)[a]
Secondary/vocational	9.8 (7.8, 12.2)	90.2 (87.8, 92.2)
University	7.3 (4.1, 12.6)	92.7 (87.4, 95.9)
All combined	8.5 (6.9, 10.5)	91.5 (89.5, 93.1)

[a]P<0.05

Overall, just under one in eleven participants reported playing a contact sport. Twice as many males than females did so. Significantly more people aged 18-24 years and 25-34 years than those in older age groups reported participating in contact sport. Data on mouthguard use for contact sports by sociodemographic characteristics are presented in Table 28.

Table 28. Mouthguard worn among those who participate in contact sport, by sociodemographic characteristics (data are row percentages; brackets contain 95% CI)

	Mouthguard worn			
	Always	Often/Sometimes/ Occasionally	Never	Never/don't know/refused
Sex				
Female	13.0 (4.1, 34.5)	1.8 (0.5, 5.9)	78.9 (56.3, 91.6)	6.3 (0.8, 36.1)
Male	32.9 (21.1, 47.4)	9.1 (3.6, 21.1)	58.0 (43.8, 71.0)	0.0 (—)
Age group				
18-24	35.5 (16.4, 60.8)	4.5 (1.4, 13.6)	59.9 (35.6, 80.2)	0.0 (—)[a]
25-34	23.9 (11.0, 44.6)	11.9 (3.4, 33.7)	64.2 (43.8, 80.5)	0.0 (—)
35-44	17.8 (9.1, 31.8)	4.4 (0.5, 28.5)	77.8 (60.2, 89.0)	0.0 (—)
45-54	12.5 (3.7, 34.6)	1.3 (0.2, 6.6)	67.5 (27.6, 91.9)	18.7 (1.8, 74.0)
55-64	83.2 (19.7, 99.0)	0.0 (—)	16.8 (1.0, 80.3)	0.0 (—)
Ethnic group				
Māori	31.0 (20.2, 44.3)	16.4 (8.4, 29.6)	52.7 (40.7, 64.3)	0.0 (—)
Pacific	59.4 (32.4, 81.7)	5.1 (0.5, 35.0)	35.5 (15.5, 62.2)	0.0 (—)
Asian	36.3 (11.9, 70.7)	0.0 (—)	63.7 (29.3, 88.1)	0.0 (—)
European/Other	18.8 (9.6, 33.6)	8.1 (3.2, 19.3)	69.8 (54.2, 81.9)	3.2 (0.4, 20.7)
Deprivation quintile				
1 (least deprived)	4.2 (0.8, 18.0)	2.3 (0.2, 19.0)	93.5 (76.1, 98.5)	0.0 (—)
2	18.5 (4.7, 50.8)	2.8 (0.5, 13.7)	67.5 (36.4, 88.3)	11.3 (1.3, 56.0)
3	38.0 (18.9, 61.7)	1.6 (0.4, 6.5)	60.4 (37.3, 79.6)	0.0 (—)
4	26.1 (10.2, 52.3)	17.2 (4.3, 49.2)	56.7 (30.9, 79.3)	0.0 (—)
5 (most deprived)	26.1 (12.6, 46.3)	7.3 (2.4, 20.4)	66.6 (46.0, 82.3)	0.0 (—)
Highest education level				
Primary	35.9 (9.6, 74.7)	3.7 (0.4, 26.3)	60.4 (23.5, 88.3)	0.0 (—)
Secondary/vocational	30.2 (19.7, 43.4)	7.3 (2.9, 17.4)	59.6 (46.5, 71.5)	2.8 (0.4, 18.3)
University	5.9 (1.4, 22.5)	3.4 (0.9, 11.7)	90.7 (74.8, 97.0)	0.0 (—)
All combined	25.8 (17.1, 37.1)	6.5 (2.8, 14.2)	65.4 (53.9, 75.4)	2.2 (0.3, 14.7)

[a]P<0.05

About one-quarter of those who reported participating playing in a contact sport reported always wearing a mouthguard. Just under 7% reported that they occasionally or often wore a mouthguard, and over two-thirds reported that they never did. People in the 35-44 and 45-54 age groups were more likely to never wear a mouthguard, and this was statistically significant. There were no other statistically significant differences.

4.2 Descriptive analysis of dental trauma in adults (2009 New Zealand Oral Health Survey clinical examination data)

Data from the 2009 NZOHS clinical examination are presented in this section.

The sociodemographic characteristics of NZ adults with signs of dental trauma of the maxillary permanent six anterior teeth are presented in Table 29.

Table 29. Clinical signs of trauma on teeth 13-23 by sociodemographic characteristics (data are row percentages; brackets contain 95% CI)

	Clinical trauma 13-23	
	Yes	No
Sex		
Female	19.8 (16.9, 23.0)	80.2 (77.0, 83.1)[a]
Male	27.3 (23.5, 31.5)	72.7 (68.5, 76.5)
Age group		
18-24	17.1 (11.0, 25.6)	80.6 (74.4, 89.0)[a]
25-34	19.4 (13.7, 26.8)	80.6 (73.2, 86.3)
35-44	32.9 (26.8, 39.6)	67.1 (60.4, 73.2)
45-54	27.3 (21.4, 34.2)	72.7 (65.8, 78.6)
55-64	18.8 (13.5, 25.7)	81.2 (74.3, 86.5)
65-74	17.6 (11.7, 25.7)	82.4 (74.3, 88.3)
75+	17.0 (10.8, 25.8)	83.0 (74.2, 89.2)
Ethnic group		
Māori	27.2 (22.7, 32.1)	72.8 (67.9, 77.3)
Pacific	29.6 (22.1, 38.4)	70.4 (61.6, 77.9)
Asian	22.7 (15.3, 32.3)	77.3 (67.7, 84.7)
European/Other	23.4 (20.6, 26.4)	76.6 (73.6, 79.4)
Deprivation quintile		
1 (least deprived)	24.9 (19.3, 31.5)	75.1 (68.5, 80.7)
2	21.5 (16.3, 27.9)	78.5 (72.1, 83.8)
3	23.6 (17.7, 30.8)	76.4 (69.2, 82.3)
4	21.0 (16.1, 27.0)	79.0 (73.0, 83.9)
5 (most deprived)	26.3 (21.2, 32.2)	73.7 (67.8, 78.8)
Highest education level		
Primary	21.4 (15.7, 28.5)	78.6 (71.5, 84.3)
Secondary/vocational	22.8 (19.9, 26.1)	77.2 (73.9, 80.1)
University	26.0 (20.0, 33.0)	74.0 (67.0, 80.0)
All combined	23.4 (21.0, 26.0)	76.6 (74.0, 79.0)

[a]P<0.05

Overall, just under one in four adults had clinical signs of dental trauma to the six maxillary anterior teeth. There was a significant sex difference, with one in five females and more than one in four males affected. A significantly higher proportion of people in the 35-44 year-old age group had experienced dental trauma than those in the other age groups, but there was no consistent age gradient. Supplementary tables are presented in Appendix VIII (Tables 67 and 68). Data on the number of teeth affected by dental trauma by sociodemographic characteristics are presented in Table 30.

Table 30. Number of permanent maxillary anterior teeth showing signs of having been traumatised (data are row percentages; brackets contain 95% CI)

	Number of teeth affected by trauma (13-23)						
	0	1	2	3	4	5	6
Sex							
Female	80.2 (77.0, 83.1)	12.4 (10.3, 15.0)	5.7 (4.1, 8.0)	1.0 (0.4, 2.6)	0.4 (0.2, 1.0)	0.0 (—)	0.2 (0.0, 0.9)
Male	72.7 (68.5, 76.5)	17.5 (14.1, 21.5)	7.3 (5.3, 10.1)	1.5 (0.8, 3.0)	0.4 (0.1, 1.0)	0.1 (0.0, 08)	0.5 (0.1, 1.8)
Age group							
18-24	82.9 (74.4, 89.0)	9.9 (5.6, 16.9)	4.6 (1.7, 11.6)	2.6 (0.6, 9.7)	0.0 (—)	0.0 (—)	0.0 (—)[a]
25-34	80.6 (73.2, 86.3)	11.6 (7.1, 18.3)	7.2 (4.0, 12.6)	0.2 (0.0, 1.1)	0.4 (0.1, 1.6)	0.0 (—)	0.0 (—)
35-44	67.1 (60.4, 73.2)	22.5 (17.6, 28.3)	8.7 (5.5, 13.6)	1.7 (0.6, 4.2)	0.1 (0.0, 0.4)	0.0 (—)	0.0 (—)
45-54	72.7 (65.8, 78.6)	18.1 (13.1, 24.4)	7.3 (4.5, 11.6)	0.5 (0.2, 1.2)	0.7 (0.3, 2.0)	0.0 (—)	0.7 (0.1, 4.9)
55-64	81.2 (74.3, 86.5)	13.1(8.6, 19.6)	4.1 (2.3, 7.2)	1.2 (0.3, 4.9)	0.4 (0.1, 2.7)	0.0 (—)	0.0 (—)
65-74	82.4 (74.3, 86.5)	8.5 (4.6, 15.2)	5.6 (2.7, 11.3)	1.4 (0.2, 7.5)	0.0 (—)	0.0 (—)	0.0 (—)
75+	83.0 (74.2, 89.2)	7.3 (3.4, 15.0)	4.3 (1.7, 10.4)	3.0 (0.7, 11.4)	1.4 (0.2, 9.6)	0.9 (0.1, 6.7)	0.1 (0.0, 1.2)
Ethnic group							
Māori	72.8 (67.9, 77.3)	16.8 (13.3, 20.9)	8.5 (6.3, 11.4)	1.1 (0.5, 2.3)	0.7 (0.3, 1.8)	0.0 (—)	0.1 (0.0, 0.5)
Pacific	70.4 (61.6, 77.9)	16.8 (10.8, 25.1)	8.6 (4.0, 17.5)	3.6 (0.8, 14.3)	0.6 (0.1, 4.1)	0.0 (—)	0.1 (0.0, 1.2)
Asian	77.3 (67.7, 84.7)	18.6 (11.7, 28.2)	3.5 (2.1, 5.9)	0.3 (0.1, 1.1)	0.4 (0.0, 2.8)	0.0 (—)	0.0 (—)
European/Other	76.6 (73.6, 79.4)	14.2 (11.9, 16.9)	7.0 (5.5, 9.0)	1.4 (0.8, 2.5)	0.3 (0.1, 0.8)	0.1 (0.0, 0.5)	0.4 (0.1, 1.2)
Deprivation quintile							
1 (least deprived)	75.1 (68.5, 80.7)	14.5 (9.9, 20.9)	8.3 (5.4, 12.6)	2.0 (0.6, 6.1)	0.1 (0.0, 0.3)	0.0 (—)	0.0 (—)
2	78.5 (72.1, 83.8)	12.5 (8.8, 17.5)	5.9 (3.2, 10.4)	1.8 (0.8, 4.3)	0.8 (0.2, 2.6)	0.0 (—)	0.5 (0.1, 2.2)
3	76.4 (69.2, 82.3)	15.6 (10.6, 22.4)	5.9 (3.5, 9.8)	0.6 (0.1, 2.7)	0.5 (0.1, 1.9)	0.0 (—)	1.0 (0.2, 4.7)
4	79.0 (73.0, 83.9)	14.3 (10.1, 19.8)	5.7 (3.5, 9.2)	0.7 (0.2, 2.1)	0.0 (—)	0.3 (0.0, 1.9)	0.0 (0.0, 0.3)
5 (most deprived)	73.7 (76.8, 78.8)	18.0 (13.9, 23.0)	6.6 (3.9, 11.1)	1.1 (0.3, 4.8)	0.5 (0.2, 1.6)	0.0 (—)	0.0 (0.0, 0.4)
Highest education level							
Primary	78.6 (71.5, 84.3)	10.6 (6.6, 16.5)	6.5 (4.0, 10.4)	1.8 (0.5, 6.1)	1.8 (0.7, 5.0)	0.0 (—)	0.8 (0.1, 5.6)
Secondary/vocational	77.2 (73.9, 80.1)	14.5 (12.1, 17.1)	6.6 (5.0, 8.7)	1.3 (0.7, 2.6)	0.1 (0.0, 0.4)	0.1 (0.0, 0.6)	0.3 (0.1, 1.3)
University	74.0 (67.0, 80.0)	18.1 (13.1, 24.4)	6.2 (3.5, 10.7)	0.9 (0.3, 3.2)	0.5 (0.1, 1.7)	0.0 (—)	0.3 (0.1, 1.8)
All combined	76.6 (74.0, 79.0)	14.9 (12.8, 17.2)	6.5 (5.2, 8.1)	1.3 (0.8, 2.1)	0.4 (0.2, 0.7)	0.1 (0.0, 0.4)	0.3 (0.1, 1.0)

[a] $P<0.05$

Of the 23% of the population who had one or more traumatised teeth, 15% had one traumatised tooth, 7% had two, and 1% had three. Almost one-quarter of the 35-44 year-old age group had traumatised only one tooth, and this was statistically significant. Almost 9% in the same age group had traumatised two teeth (9%), and this was significantly greater than in some of the older and younger age groups. Data on dental trauma characteristics by tooth type are presented in Table 31 and Figures 2-3.

Table 31. Dental trauma type by tooth type (data are column percentages, brackets contain 95% confidence intervals)

	Tooth type					
	13	12	11	21	22	23
Trauma type						
No trauma	98.7 (97.7, 99.3)	95.4 (93.6, 96.8)	84.6 (82.3, 86.6)	86.7 (84.6, 88.5)	95.9 (94.5, 96.9)	99.1 (98.4, 99.5)
Treated trauma	0.3 (0.1, 1.1)	1.9 (1.1, 3.2)	6.4 (5.0, 8.2)	5.4 (4.2, 7.1)	1.4 (0.8, 2.5)	0.2 (0.0, 1.0)
Enamel trauma, not treated	0.4 (0.1, 1.2)	1.5 (0.8, 2.8)	5.3 (4.1, 6.7)	4.9 (3.8, 6.3)	1.3 (0.7, 2.3)	0.1 (0.0, 0.6)
Trauma dentine or more, not treated	0.1 (0.0, 0.3)	0.1 (0.0, 0.3)	0.8 (0.4, 1.5)	0.5 (0.2, 0.9)	0.3 (0.1, 0.6)	0.0 (0.0, 0.1)
Discoloured after trauma	0.1 (0.0, 0.3)	0.0 (0.0, 0.2)	0.9 (0.5, 1.6)	1.0 (0.5, 1.9)	0.0 (0.0, 0.1)	0.0 (—)
Avulsed, luxated	0.3 (0.1, 1.0)	1.0 (0.5, 1.8)	1.9 (1.2, 2.8)	1.5 (0.9, 2.4)	1.0 (0.6, 1.7)	0.4 (0.1, 1.1)
Not able to be scored	0.2 (0.1, 0.6)	0.1 (0.0, 0.5)	0.2 (0.1, 0.7)	0.0 (0.0, 0.2)	0.2 (0.0, 0.6)	0.1 (0.1, 0.4)
Total	100.0	100.0	100.0	100.0	100.0	100.0

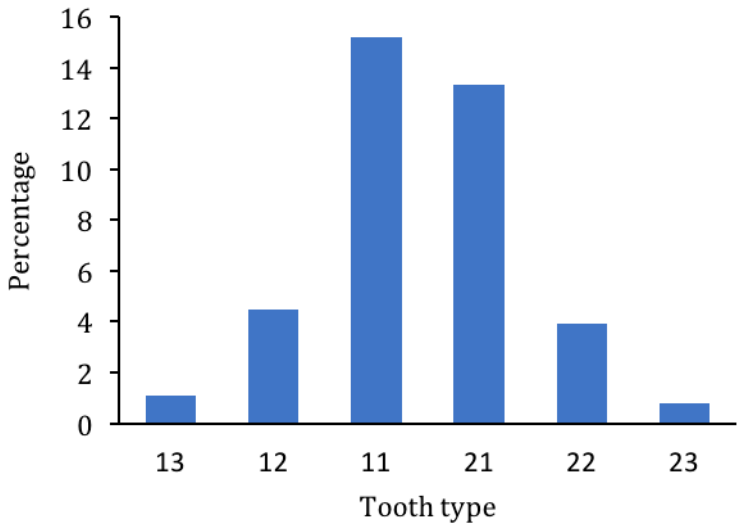

Figure 2. Proportion of anterior teeth with clinical dental trauma by tooth type (including missing due to trauma)

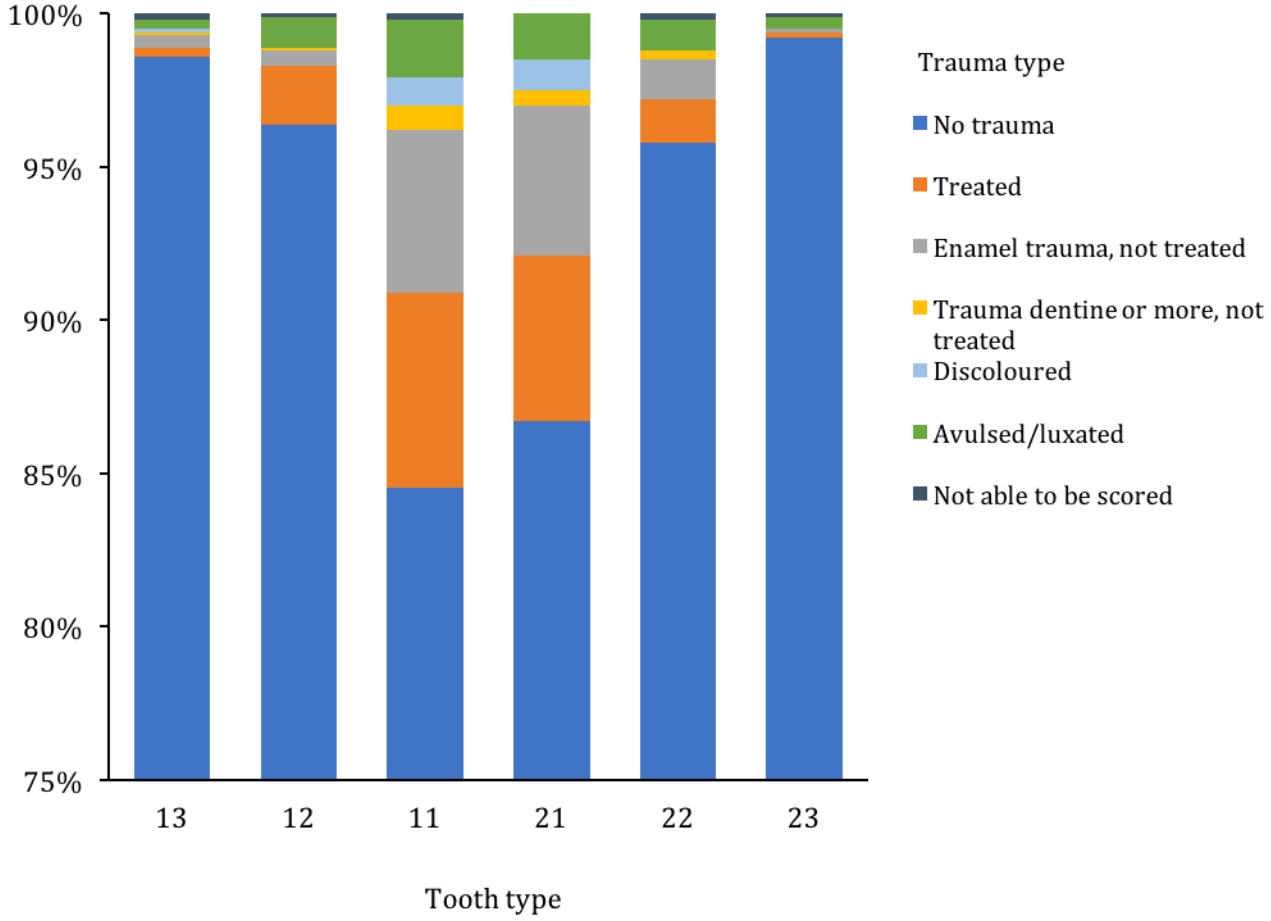

Figure 3. Occurrence of clinically observed trauma by tooth type

Teeth 11 and 21 had a higher prevalence of dental trauma than lateral incisors and canines. Teeth on the right side appeared to more commonly have signs of dental trauma. Data on dental trauma characteristics by sociodemographic characteristics are presented in Table 32.

Table 32. Observed trauma of teeth 13-23, by sociodemographic characteristics (data are row percentages; brackets contain 95% CI)

	Trauma type				
	Treated trauma	Enamel trauma, not treated	At least dentine trauma, not treated	Discoloured after trauma	Avulsed/luxated[a]
Sex					
Male	11.1 (8.8, 14.1)	9.5 (6.9, 12.8)	1.8 (0.9, 3.3)[b]	1.8 (1.0, 3.4)	3.4 (2.2, 5.1)[b]
Female	8.2 (6.2, 10.9)	7.7 (6.0, 9.7)	0.7 (0.4, 1.1)	1.4 (0.8, 2.6)	1.5 (0.8, 2.8)
Age group					
18-24	6.9 (3.1, 14.4)	9.1 (5.2, 15.5)[b]	0.4 (0.1, 3.6)	0.3 (0.0, 2.3)[b]	0.0 (—) [a]
25-34	8.5 (5.0, 14.0)	8.2 (4.8, 13.6)	2.1 (0.9, 4.7)	0.7 (0.2, 1.8)	0.5 (0.1, 3.4)
35-44	13.2 (9.0, 19.1)	15.6 (11.6, 20.6)	0.7 (0.3, 1.4)	2.2 (1.1, 4.5)	1.5 (0.7, 3.5)
45-54	11.1 (7.1, 16.8)	8.1 (5.2, 12.5)	1.8 (0.6, 5.4)	2.4 (1.0, 5.9)	3.2 (1.6, 6.6)
55-64	6.7 (3.8, 11.6)	4.4 (2.2, 8.5)	1.2 (0.4, 3.7)	0.7 (0.1, 5.2)	3.4 (1.5, 7.3)
65-74	7.5 (4.1, 13.4)	0.7 (0.2, 2.9)	0.4 (0.1, 2.1)	4.8 (1.9, 11.9)	5.8 (2.6, 12.3)
75+	9.8 (5.1, 18.0)	2.8 (1.0, 7.5)	0.9 (0.2, 3.8)	0.0 (—)	6.9 (3.1, 14.5)
Ethnic group					
Māori	7.2 (5.4, 9.4)[b]	14.1 (7.1, 10.3)[b]	2.9 (1.6, 5.3)[b]	1.3 (0.4, 3.9)	2.6 (1.7, 4.1)
Pacific	12.2 (6.5, 21.7)	13.9 (8.1, 22.6)	4.6 (2.0, 10.2)[b]	1.1 (0.2, 5.7)	1.2 (0.3, 5.7)
Asian	4.4 (2.1, 8.9)[b]	10.4 (6.0, 17.6)	2.3 (0.8, 6.9)	2.5 (1.2, 5.0)	1.6 (0.5, 4.8)
European/Other	10.6 (8.7, 13.0)[b]	7.9 (6.3, 9.8)[b]	0.9 (0.5, 1.6)[b]	1.6 (1.0, 2.8)	2.5 (1.7, 3.6)
Deprivation quintile					
1 (least deprived)	12.0 (7.8, 17.9)	8.4 (5.1, 13.7)	1.5 (0.4, 5.4)	1.7 (0.4, 6.5)	2.8 (1.2, 6.2)
2	11.9 (8.3, 16.9)	5.9 (3.6, 9.7)	0.9 (0.3, 2.7)	0.5 (0.1, 2.6)	3.0 (1.6, 5.6)
3	6.7 (4.3, 10.4)	8.8 (5.5, 13.9)	0.9 (0.4, 2.5)	3.2 (1.6, 6.5)	2.8 (1.3, 6.0)
4	6.0 (3.5, 10.0)	11.5 (7.7, 16.7)	0.7 (0.3, 1.5)	1.5 (0.6, 3.7)	1.1 (0.4, 2.7)
5 (most deprived)	11.2 (7.4, 16.5)	8.2 (5.5, 12.2)	1.9 (0.9, 3.8)	1.3 (0.5, 3.5)	2.2 (1.0, 4.7)
Highest education level					
Primary	8.1 (4.3, 14.6)	6.5 (3.6, 11.5)	3.3 (1.8, 5.9)[a]	0.6 (0.1, 3.1)	5.6 (3.2, 9.6)[a]
Secondary/vocational	10.0 (7.9, 12.5)	8.1 (6.4, 10.2)	1.1 (0.5, 2.1)	1.9 (1.2, 3.3)	2.0 (1.2, 3.3)
University	9.2 (6.0, 14.1)	10.9 (7.2, 16.1)	0.6 (0.3, 1.5)	1.1 (0.4, 3.0)	2.1 (0.9, 4.9)
All combined	9.6 (8.0, 11.5)	8.5 (7.1, 10.3)	1.2 (0.7, 1.9)	1.6 (1.0, 2.5)	2.4 (1.7, 3.4)

[a] Observations of "no trauma" and "not able to be scored (primary tooth, unerupted tooth, tooth missing for reasons other than trauma)" were not included in this table

[b] $P<0.05$

The most common trauma observation was trauma that had been "treated" (10%), which included injuries of any size or involvement. The second most common observation was "trauma limited to enamel and not treated" (9%). Some 1% of participants had "trauma involving at least dentine, requiring treatment but not yet treated". Some 2% had teeth that were "discoloured after trauma", and 2% had teeth "avulsed or luxated".

Significantly more males than females had trauma that involved "at least dentine and which required treatment but had not yet been treated" (2% and 1% respectively). More males than females had experienced an "avulsed or luxated" maxillary anterior tooth (3% and 2% respectively), and this was also statistically significant.

More participants in the 35-44 year age group had "enamel trauma that had not been treated" (16%), and this was significantly higher than for people aged 55 years and older. More people aged 65-74 years had had a "discoloured tooth after trauma" (5%), and this was significantly more than people aged 25-34 years. None of the participants in the 18-24 age group had had an "avulsed or luxated" tooth. There was a consistent gradient by age group, with more participants aged 75 years and older having experienced an "avulsed or luxated" tooth.

Significantly fewer Māori and Asian participants than non-Māori and non-Asian participants had "treated trauma". Significantly more European/other had treated trauma than the other ethnic groups. More Māori than non-Māori had "enamel trauma that wasn't treated" (14%) and fewer European/other had enamel trauma compared with other ethnicities (8%). More Māori and Pacific people than other ethnic groups had trauma involving "at least dentine that had not yet been treated" (3% and 5% respectively).

There was a consistent gradient by education, with people with a university education less likely to have "untreated trauma involving at least dentine". In addition to this, significantly more people with only primary school education than secondary school or vocational education had an "avulsed or luxated" tooth

(6% and 2% respectively). Multivariate analyses of self-reported trauma and clinical dental trauma are presented in the following section.

4.3 Multivariate analyses using logistic regression modelling (2009 NZOHS)

Multivariate analyses of self-reported orofacial trauma, self-reported dental trauma and clinical signs of dental trauma are presented in this section.

Multivariate logistic regression of self-reported orofacial trauma is presented in Table 33.

Table 33. Multivariate logistic regression models for self-reported orofacial trauma.

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	OR (95% CI%)	*P*	OR (95% CI%)	*P*	OR (95% CI%)	*P*	OR (95% CI%)	*P*
Sex (ref female)								
Male	2.36 (1.77, 3.14)	<0.001	2.45 (1.84, 3.30)	<0.001	2.47 (1.85, 3.28)	<0.001	2.46 (1.84, 3.28)	<0.001
Age group (ref 18-24)								
25-34	1.59 (0.82, 3.07)	0.164	1.61 (0.82, 3.16)	0.160	1.75 (0.88, 3.49)	0.110	1.76 (0.89, 3.50)	0.105
35-44	2.29 (1.28, 4.10)	0.005	2.17 (1.19, 3.95)	0.012	2.32 (1.26, 4.26)	0.007	2.37 (1.28. 4.37)	0.006
45-54	1.87 (1.03, 3.43)	0.041	1.81 (0.97, 3.39)	0.063	1.88 (1.00, 3.53)	0.051	1.91 (1.28, 4.37)	0.046
55-64	1.23 (0.64, 3.29)	0.530	1.13 (0.57, 2.27)	0.719	1.19 (0.59, 2.39)	0.630	1.23 (0.61, 2.51)	0.506
65-74	1.66 (0.86, 3.24)	0.131	1.51 (0.78, 2.94)	0.219	1.57 (0.81, 3.04)	0.181	1.61 (0.82, 3.15)	0.165
75+	0.85 (0.40, 1.82)	0.672	0.77 (0.35, 1.70)	0.517	0.81 (0.36, 1.83)	0.609	0.85 (0.37, 1.92)	0.688
Ethnic group (ref Asian)								
Māori			1.65 (1.22, 2.22)	0.001	1.61 (1.18, 2.20)	0.003	1.65 (1.21, 2.25)	0.002
Pacific			0.96 (0.640, 1.44)	0.843	0.89 (0.60, 1.34)	0.584	0.91 (0.61, 1.36)	0.636
European/Other			2.18 (1.59, 2.99)	<0.001	2.26 (1.62, 3.14)	<0.001	2.22 (1.60, 3.09)	<0.001
Deprivation quintile (ref 1)								
2 (least deprived)					1.42 (0.96, 2.10)	0.080	1.41 (0.95, 2.08)	0.085
3					0.88 (0.59, 1.31)	0.523	0.87 (0.58, 1.31)	0.500
4					0.99 (0.66, 1.50)	0.975	0.98 (0.65, 1.48)	0.927
5 (most deprived)					1.33 (0.81, 2.17)	0.253	1.33 (0.81, 2.19)	0.253
Highest education level (ref primary)								
Secondary/vocational							1.31 (0.87, 1.97)	0.188
University							1.19 (0.73, 1.93)	0.481
Goodness-of-fit test	F(9,91) = 0.41 Prob > F = 0.9283		F(9,91) = 0.81 Prob > F = 0.6107		F(9,91) = 0.60 Prob > F = 0.7931		F(9,91) = 1.51 Prob > F = 0.1571	

Across all models, being male, aged 35-44 years old, or being Māori and European/other was positively associated with self-reported orofacial trauma. When adjusted for all variables, males were 2.5 times more likely than females to have experienced orofacial trauma. People aged 35-44 years were 2.4 times more likely than those aged 18-24 years to have had orofacial trauma, and those aged 45-54 were almost twice as likely. Māori were 1.7 times more likely than Asian people to have had trauma, and European/other were 2.2 times more likely. A p-value of 0.1571 for the goodness-of-fit test for the fully adjusted model indicates that the final model fitted the data well. A multivariate analysis of self-reported dental trauma is presented in Table 34.

Table 34. Multivariate logistic regression models for self-reported dental trauma.

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	OR (95% CI%)	*P*	OR (95% CI%)	*P*	OR (95% CI%)	*P*	OR (95% CI%)	*P*
Sex (ref female)								
Male	0.94 (0.61, 1.44)	0.769	0.94 (0.61, 1.45)	0.791	0.95 (0.61, 1.47)	0.804	0.95 (0.61, 1.48)	0.817
Age group (ref 18-24)								
25-34	1.65 (0.66, 4.16)	0.283	1.66 (0.66, 4.19)	0.279	1.60 (0.63, 4.04)	0.318	1.63 (0.64, 4.19)	0.304
35-44	2.96 (1.27, 6.90)	0.012	2.91 (1.25, 6.76)	0.014	2.78 (1.18, 6.54)	0.019	2.84 (1.19, 6.76)	0.019
45-54	3.25 (1.31, 8.04)	0.011	3.19 (1.28, 7.97)	0.014	3.07 (1.22, 7.75)	0.018	3.10 (1.22, 7.88)	0.018
55-64	2.54 (0.99, 6.47)	0.051	2.46 (0.96, 6.29)	0.061	2.37 (0.92, 6.07)	0.073	2.42 (0.88, 6.61)	0.085
65-74	4.23 (1.44, 12.44)	0.009	4.07 (1.37, 12.10)	0.012	4.02 (1.34, 12.07)	0.014	4.02 (1.32, 12.18)	0.015
75+	6.34 (1.47, 27.31)	0.014	6.08 (1.40, 26.33)	0.016	5.79 (1.35, 24.88)	0.019	5.68 (1.31, 24.60)	0.021
Ethnic group (ref Asian)								
Māori			0.90 (0.59, 1.38)	0.626	0.93 (0.61, 1.43)	0.736	0.91 (0.59, 1.41)	0.671
Pacific			0.77 (0.33, 1.80)	0.548	0.82 (0.34, 1.97)	0.654	0.80 (0.32, 1.98)	0.623
European/Other			1.08 (0.55, 2.10)	0.827	1.09 (0.56, 2.13)	0.797	1.09 (0.55, 2.15)	0.798
Deprivation quintile (ref 1)								
2 (least deprived)					0.80 (0.38, 1.68)	0.553	0.79 (0.38, 1.67)	0.541
3					0.79 (0.36, 1.74)	0.553	0.78 (0.35, 1.73)	0.535
4					0.91 (0.44, 1.87)	0.798	0.90 (0.44, 1.86)	0.774
5 (most deprived)					0.78 (0.36, 1.67)	0.518	0.76 (0.35, 1.64)	0.479
Highest education level (ref primary)								
Secondary/vocational							0.90 (0.45, 1.81)	0.769
University							0.80 (0.36, 1.77)	0.575
Goodness-of-fit test	F(9,91) = 0.10 Prob > F = 0.9995		F(9,91) = 0.24 Prob > F = 0.9874		F(9,91) = 0.59 Prob > F = 0.8004		F(9,91) = 0.29 Prob > F = 0.9753	

Across all models, being aged 35-54 years and 65 years and older was positively associated with self-reported dental trauma. When adjusted for all variables, people aged 35-44 were 2.8 times more likely than people aged 18-24 years old to have had dental trauma. There was an age gradient with odds, with older people being more likely than those aged 18-24 years to have had dental trauma. A p-value of 0.9753 for the goodness-of-fit test for the fully adjusted model indicates that the final model fitted the data well. A multivariate analysis of clinical dental trauma is presented in Table 35.

Table 35. Multivariate logistic regression models for clinical signs of dental trauma to the maxillary anterior six teeth.

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	OR (95% CI%)	*P*	OR (95% CI%)	*P*	OR (95% CI%)	*P*	OR (95% CI%)	*P*
Sex (ref female)								
Male	1.55 (1.15, 2.09)	0.004	1.57 (1.17, 2.11)	0.003	1.57 (1.17, 2.13)	0.003	1.57 (1.16, 2.12)	0.004
Age group (ref 18-24)								
25-34	1.16 (0.59, 2.26)	0.666	1.15 (0.60, 2.25)	0.675	1.15 (0.58, 2.28)	0.687	1.12 (0.57, 2.21)	0.745
35-44	2.39 (1.31, 4.35)	0.005	2.39 (1.31, 4.36)	0.005	2.41 (1.30, 4.45)	0.006	2.35 (1.29, 4.30)	0.006
45-54	1.82 (0.97, 3.42)	0.062	1.85 (0.98, 3.49)	0.059	1.83 (0.96, 3.52)	0.068	1.83 (0.95, 3.51)	0.068
55-64	1.09 (0.56, 2.10)	0.797	1.11 (0.57, 2.15)	0.755	1.11 (0.57, 2.18)	0.752	1.11 (0.57, 2.16)	0.756
65-74	1.04 (0.54, 1.98)	0.914	1.06 (0.55, 2.04)	0.854	1.06 (0.54, 2.08)	0.862	1.07 (0.54, 2.11)	0.843
75+	0.98 (0.48, 2.02)	0.962	1.01 (0.48, 2.12)	0.974	1.02 (0.48, 2.16)	0.954	1.04 (0.50, 2.19)	0.907
Ethnic group (ref Asian)								
Māori			1.32 (0.93, 1.87)	0.113	1.29 (0.90, 1.86)	0.170	1.33 (0.92, 1.90)	0.125
Pacific			1.57 (0.90, 2.72)	0.109	1.45 (0.83, 2.54)	0.188	1.51 (0.86, 2.65)	0.147
European/Other			1.15 (0.75, 1.77)	0.508	1.16 (0.74, 1.82)	0.501	1.17 (0.75, 1.84)	0.481
Deprivation quintile (ref 1)								
2 (least deprived)					0.87 (0.54, 1.39)	0.550	0.88 (0.55, 1.42)	0.598
3					0.98 (0.62, 1.53)	0.914	1.00 (0.62, 1.61)	0.999
4					0.84 (0.51, 1.38)	0.481	0.86 (0.51, 1.43)	0.551
5 (most deprived)					1.12 (0.66. 1.90)	0.673	1.16 (0.67, 2.01)	0.598
Highest education level (ref primary)								
Secondary/vocational							1.12 (0.71, 1.78)	0.621
University							1.28 (0.74, 2.21)	0.373
Goodness-of-fit test	F(9,91) = 0.17 Prob > F = 0.9962		F(9,91) = 1.24 Prob > F = 0.2812		F(9,91) = 0.53 Prob > F = 0.8514		F(9,91) = 0.55 Prob > F = 0.8327	

Across all models, being male, or being aged 35-44 were positively associated with clinical signs of trauma of the six maxillary anterior teeth. In the fully adjusted model, males were 1.6 times more likely than females to have had dental trauma. Participants aged 35-44 years were 2.4 times more likely than people aged 18-24 years to have had dental trauma. A p-value of 0.8327 for the goodness-of-fit test for the fully adjusted model indicates that the final model fitted the data well. ACC results are presented in the following section.

4.4 Descriptive analysis of ACC data (2008)

Data on new orofacial injuries registered with ACC by a dentist or dental specialist are presented in this section. Tables 26-36 relate to all new injuries recorded in 2008.

Data on sociodemographic characteristics are presented in Table 36.

Table 36. Sex by other sociodemographic characteristics for 32,110 individuals who sustained orofacial trauma in 2008 (absolute numbers, percentage in parentheses; data are row percentages unless otherwise indicated)

	Sex		
	Female	Male	All combined[a]
Age group[c]			
0-4	1236 (42.5)	1669 (57.5)[b]	2905 (9.0)
5-9	1929 (38.9)	3028 (61.1)	4957 (15.4)
10-13	1213 (31.8)	2607 (68.2)	3820 (11.9)
14-17	928 (32.7)	1906 (67.3)	2834 (8.8)
18-24	1361 (32.2)	2864 (67.8)	4225 (13.2)
25-34	1367 (41.6)	1919 (58.4)	3286 (10.1)
35-44	1662 (48.2)	1785 (51.8)	3447 (10.7)
45-54	1397 (47.3)	1559 (52.7)	2956 (9.2)
55-64	839 (48.7)	883 (51.3)	1722 (5.4)
65+	584 (52.4)	531 (47.6)	1115 (3.5)
Ethnicity			
Māori	1648 (36.5)	2864 (63.5)	4512 (14.1)
Pacific	371 (35.4)	681 (64.7)	1052 (3.3)
Asian	403 (37.8)	662 (62.2)	1065 (3.3)
European	9481 (40.5)	13935 (59.5)	23416 (72.9)
Other	458 (40.2)	681 (59.8)	1139 (3.5)
Residual categories	435 (47.0)	491 (53.0)	926 (2.9)
All combined	12796 (39.9)	19314 (60.1)	32110 (100.0)

[a]Column percentage
[b]$P<0.05$
[c]Age data missing for 843 claimants

More people aged 5-9 years than any other age group had orofacial trauma registered with ACC by a dentist or dental specialist. The next most common age group was 18-24 years, followed by 10-13 years. Fewer people aged 55 years and older had their trauma registered than in the younger age groups. People aged 65 years and older represented the smallest age group presenting with trauma. Children under 18 years represented approximately 45% of the injuries. Overall, more males than females had orofacial trauma registered with ACC. This was true in all age groups, except for those who were 65 years and older. There was a greater difference between males and females presenting with trauma in those younger than 35 years old, than in the older age groups. Almost three-quarters of the people injured were European. The next most common ethnic group was Māori (one in seven). Data on injury types recorded in 2008 are presented in Table 37 and 38.

Table 37. Injury type in 32,110 individuals who sustained an orofacial injury in 2008 (data are column percentages)

	Orofacial injury
Injury type	
Dental	99.4[a]
Jaw/Alveolar/TMJ	0.8
Prosthesis	1.3
Soft tissue	0.0

[a] This column adds to more than 100 because each injury type could be recorded more than once for each claim.

Table 38. Dental injuries by other orofacial injury in 32,110 individuals who sustained an orofacial injury in 2008 (data are row percentages)

	Dental injury	
	Yes	No
Injury type		
Jaw/Alveolar/TMJ	96.8	3.2
Prosthesis	58.4	41.6
Soft tissue	100.0	0.0
All combined[a]	99.4	2.1

[a] This row adds to more than 100 because non-dental injuries could be listed more than once for each claim.

The majority of orofacial injuries registered with ACC on the ACC42 form (that is, those who were seen by a dentist or dental specialist) included dental injuries (99%). Some injuries included a dental injury and a concomitant injury to other orofacial structures. Some 97% of jaw/alveolar/TMJ injuries also included damage to teeth, while all soft tissue injuries also involved a dental injury. Just over half of the cases of trauma to a prosthesis (such as a denture) also included damage to teeth. Damage to a prosthesis represented only 1% of the total number. Data on the number and percentage of dental injuries by tooth type recorded in 2008 are presented in Tables 39 and 40.

Table 39. Number of dental injuries registered for 32,110 individuals who sustained orofacial trauma from 1st January 2008 to 31st December 2008 (absolute numbers), by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries[a]																
4	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0	0
3	0	0	0	1	0	3	11	43	38	5	3	0	0	1	0	0
2	0	4	7	9	11	29	183	477	534	139	36	13	8	12	4	3
1	53	272	516	538	596	1734	6206	14559	14381	6233	1765	626	519	543	350	69
0	32057	31834	31587	31562	31503	30344	25710	17029	17156	25731	30306	31471	31583	31554	31756	32038

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Dental injuries[a]																
0	32040	31761	31580	31774	31824	31341	29662	28462	28511	29629	31365	31835	31769	31519	31676	32018
1	70	343	519	329	281	753	2369	3524	3460	2387	735	272	333	568	428	92
2	0	5	11	7	5	16	74	118	129	89	10	3	7	22	6	0
3	0	1	0	0	0	0	5	5	9	5	0	0	1	1	0	0
4	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0

[a] All columns add up to 32,110

Table 40. Number and percentage of dental injuries registered for 32,110 individuals who sustained orofacial trauma from 1st January 2008 to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries	53	276	523	548	607	1766	6400	15081	14954	6379	1804	639	527	556	354	72
%	0.2	0.9	1.6	1.7	1.9	5.4	19.9	47.0	46.6	19.9	5.6	2.0	1.6	1.7	1.1	0.2

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
%	0.2	1.1	1.7	1.0	0.9	2.4	7.6	11.4	11.2	7.7	2.3	0.9	1.1	1.8	1.4	0.3
Dental injuries	70	349	530	336	286	769	2448	3648	3599	2481	745	275	341	591	434	92

The maxillary central and lateral incisors were the most frequently affected teeth, followed by the mandibular incisors. There did not appear to be a right or left side predilection. Many teeth had multiple injuries, and this was more common with anterior teeth. Injuries are described by a classification developed for this study (Table 41). Data on the injury characteristics by tooth type are presented in Tables 42-46 and Figures 4-5.

Table 41. Classification for ACC dental injuries for this study

Classification	Injuries as listed on the ACC42 form
Minor injury	Concussion Enamel infraction Enamel fracture
Fracture or loosening	Enamel-dentine fracture Subluxation Root fracture
Severe fracture	Complicated crown fracture Crown-root fracture
Displacement	Extrusive luxation Lateral luxation
Severe displacement	Avulsion Intrusive luxation

Table 42. Absolute number of *Minor injuries* registered for 32,110 individuals who sustained trauma from 1st January 2008 to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries[a]																
3	0	0	0	0	0	1	0	10	6	1	0	0	0	0	0	0
2	0	2	3	2	3	20	84	148	165	63	20	5	1	5	1	0
1	39	182	309	308	375	1466	4639	9019	8834	4635	1474	389	326	345	228	49
0	32071	31926	31798	31800	31732	30623	27387	22933	23105	27411	30616	31716	31783	31760	31881	32061

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Dental injuries[a]																
0	32062	31913	31824	31880	31885	31454	30114	29361	29343	30101	31470	31892	31869	31780	31861	32042
1	48	196	283	228	221	648	1963	2705	2706	1963	635	217	237	324	247	68
2	0	1	3	2	4	8	33	43	59	45	5	1	3	5	2	0
3	0	0	0	0	0	0	0	1	2	1	0	0	1	1	0	0

[a] All columns add up to 32,110

Table 43. Absolute number of *Fracture or loosening* injuries registered for 32,110 individuals who sustained trauma from 1st January2008 to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries[a]																
3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	5	18	31	4	4	0	0	0	0	0
1	3	62	157	133	132	155	1009	4223	4231	940	165	138	107	153	91	17
0	32107	32048	31953	31977	31978	31955	31096	27869	27847	31166	31941	31972	32003	31957	32019	32093

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Dental injuries[a]																
0	32096	31989	31936	32032	32072	32029	31746	31389	31429	31740	32030	32069	32055	31914	31966	32097
1	14	121	174	78	38	81	362	715	677	366	80	41	55	195	144	13
2	0	0	0	0	0	0	2	6	4	4	0	0	0	1	0	0

[a] All columns add up to 32,110

Table 44. Absolute number of *Severe fracture* injuries registered for 32,110 individuals who sustained trauma from 1st January 2008 to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries[a]																
3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2	0	0	0	1	0	1	2	9	4	4	1	0	0	0	1	0
1	10	29	51	102	98	100	584	1421	1461	613	126	104	91	63	34	9
0	32100	32081	32059	32007	32012	32009	31524	30679	30645	31493	31983	32006	32019	32047	32075	32101

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Dental injuries[a]																
0	32104	32078	32036	32080	32096	32090	32049	31994	32001	32024	32089	32094	32063	32031	32066	32103
1	6	32	74	30	14	19	61	115	109	84	21	16	47	79	44	7
2	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0

[a] All columns add up to 32,110

Table 45. Absolute number of *Displacement* injuries registered for 32,110 individuals who sustained trauma from 1st January 2008 to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries[a]																
2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
1	1	0	4	3	2	18	103	329	330	123	17	5	5	1	1	0
0	32109	32110	32106	32107	32108	32092	32006	31780	31779	31987	32093	32105	32105	32109	32109	32110

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Dental injuries[a]																
0	32109	32106	32108	32108	32106	32098	32062	32015	32033	32074	32104	32108	32108	32108	32109	32106
1	1	4	2	2	4	12	48	95	77	36	6	2	2	2	1	4

[a] All columns add up to 32,110

Table 46. Absolute number of *Severe displacement* injuries registered for 32,110 individuals who sustained trauma from 1st January2008 to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Dental injuries[a]																
2	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
1	0	3	3	7	5	17	86	269	284	78	14	6	4	0	0	0
0	32110	32107	32107	32103	32105	32093	32024	31839	31824	32032	32096	32104	32106	32110	32110	32110

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Dental injuries[a]																
0	32109	32109	32108	32109	32104	32103	32082	32064	32062	32084	32107	32110	32110	32110	32110	32110
1	1	1	2	1	6	7	28	46	48	26	3	0	0	0	0	0

[a] All columns add up to 32,110

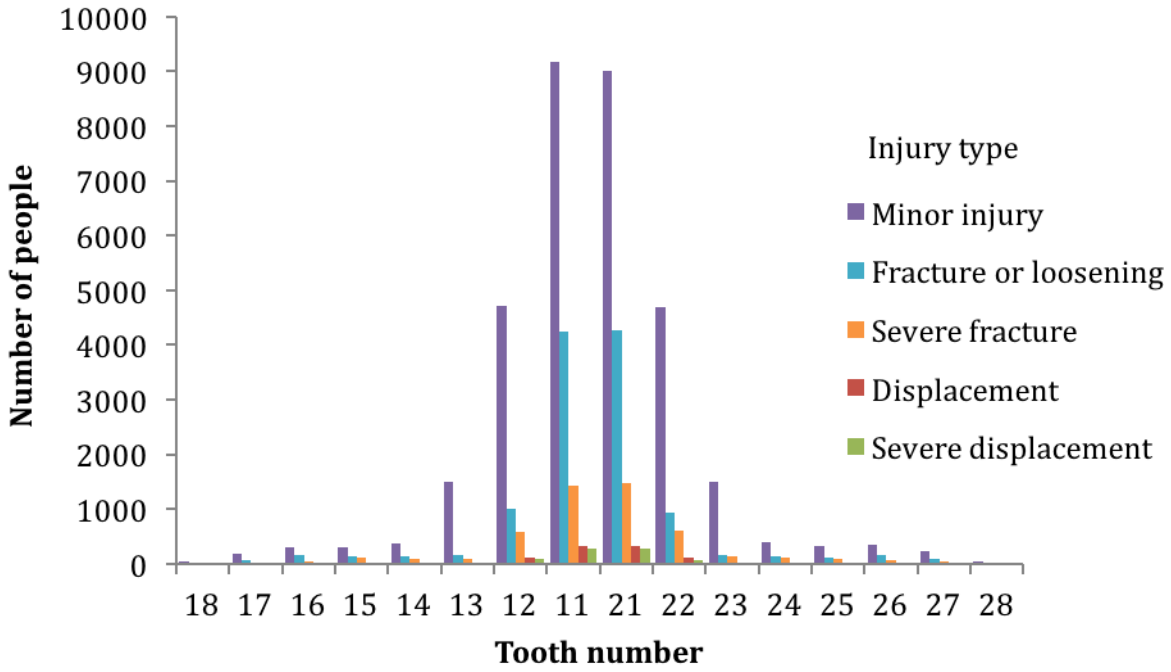

Figure 4. Maxillary teeth injury classifications for 32,110 people with orofacial injuries in 2008

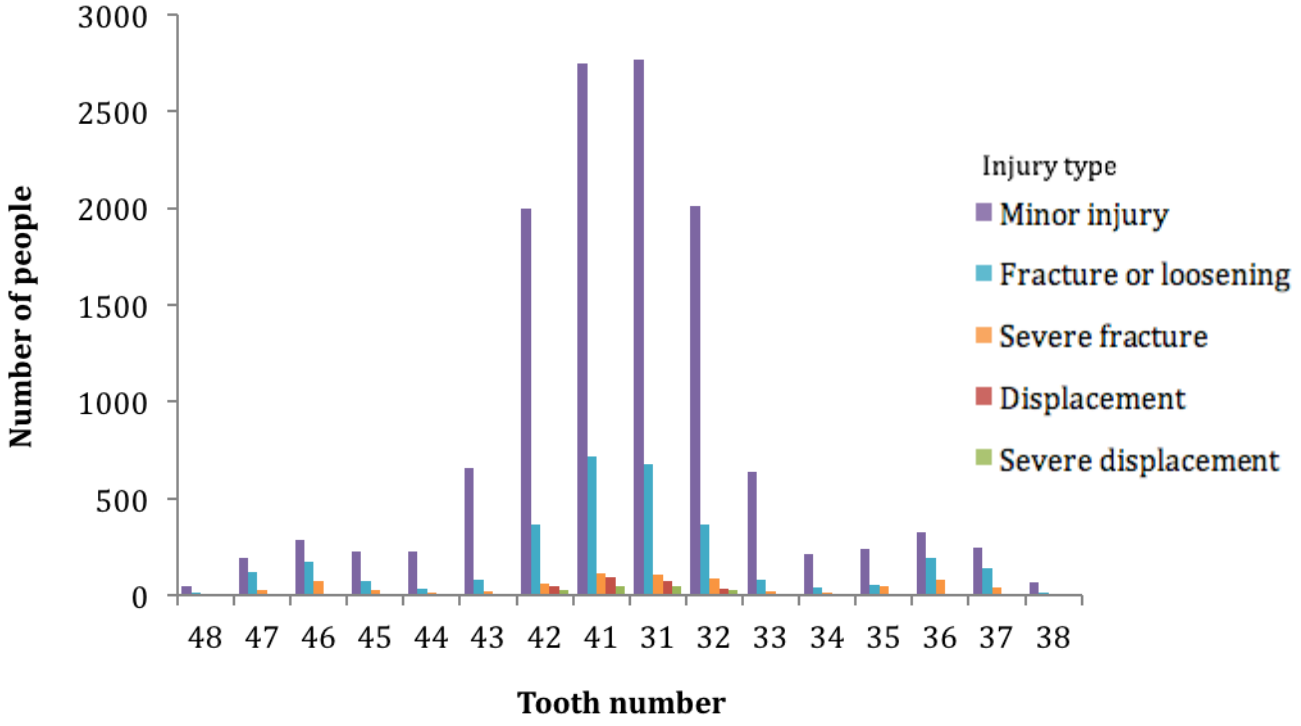

Figure 5. Mandibular teeth injury classifications for 32,110 people with orofacial injuries in 2008

There were more people with *Minor injuries* than other dental injuries, and *Minor injuries* were the most common for each tooth. It was more common to have multiple *Minor injuries* registered per tooth than for other injuries. *Fracture or loosening* injuries were the next most common, followed by *Severe fractures*. *Displacement* and *Severe displacement* injuries were more common in the maxillary incisor teeth than in other teeth. Data on the number of injuries by tooth type are presented in Table 47 and Figures 6-7.

Table 47. Absolute number of injuries for 32,110 individuals who sustained trauma from 1st January to 31st December 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Injury type																
Severe displacement	0	3	3	7	5	17	86	271	286	78	14	6	4	0	0	0
Displacement	1	0	4	3	2	18	104	330	331	123	17	5	5	1	1	0
Severe fracture	10	29	51	103	98	101	586	1431	1465	617	127	104	91	63	34	9
Fracture or loosening	3	62	157	133	132	155	1014	4241	4263	944	169	138	107	153	91	17
Minor injury	39	184	312	310	378	1486	4723	9177	9005	4699	1494	394	327	350	229	49
All combined	53	278	527	556	615	1777	6513	15450	15350	6461	1821	647	534	567	355	75

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Injury type																
Minor injury	48	197	286	230	225	656	1996	2749	2767	2009	640	218	241	330	249	68
Fracture or loosening	14	121	174	78	38	81	364	721	681	370	80	41	55	196	144	13
Severe fracture	6	32	74	30	14	20	61	116	109	86	21	16	47	79	44	7
Displacement	1	4	2	2	4	12	48	95	77	36	6	2	2	2	1	4
Severe displacement	1	1	2	1	6	7	28	46	48	26	3	0	0	0	0	0
All combined	70	355	538	341	287	776	2497	3727	3682	2527	750	277	345	607	438	75

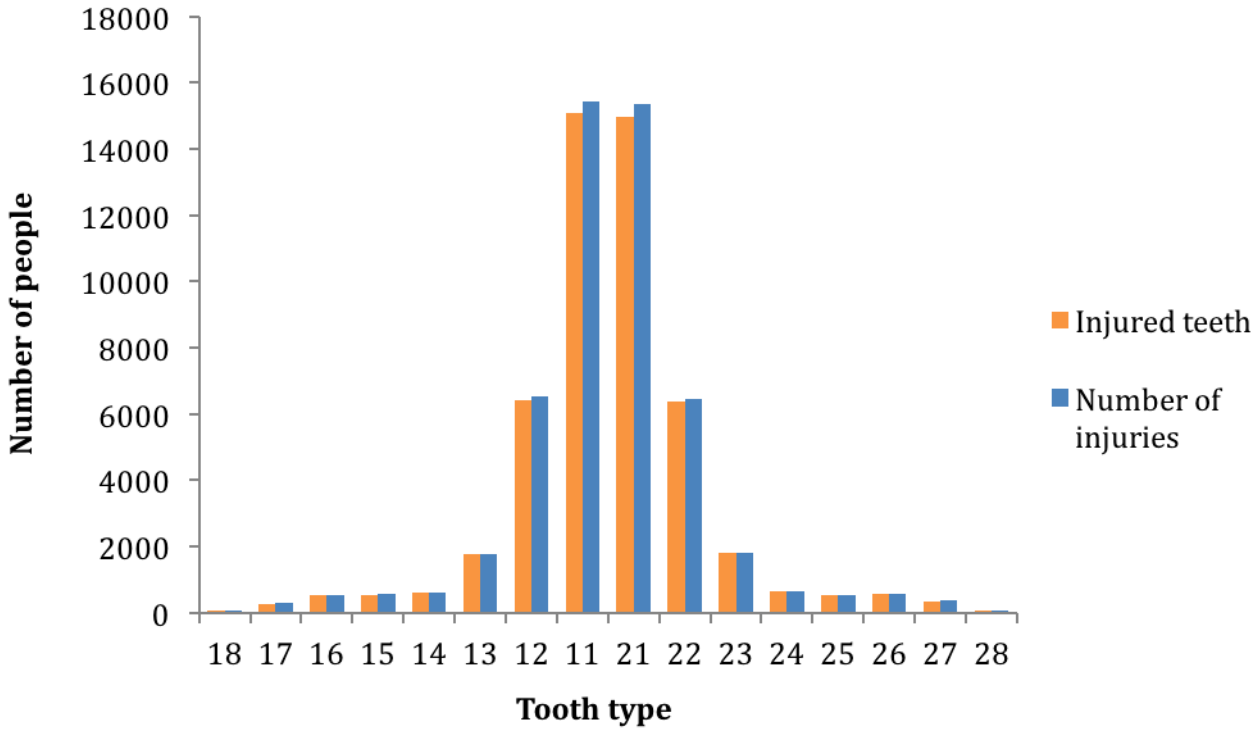

Figure 6. Absolute number of injured teeth and number of dental injuries among 32,110 people with orofacial trauma

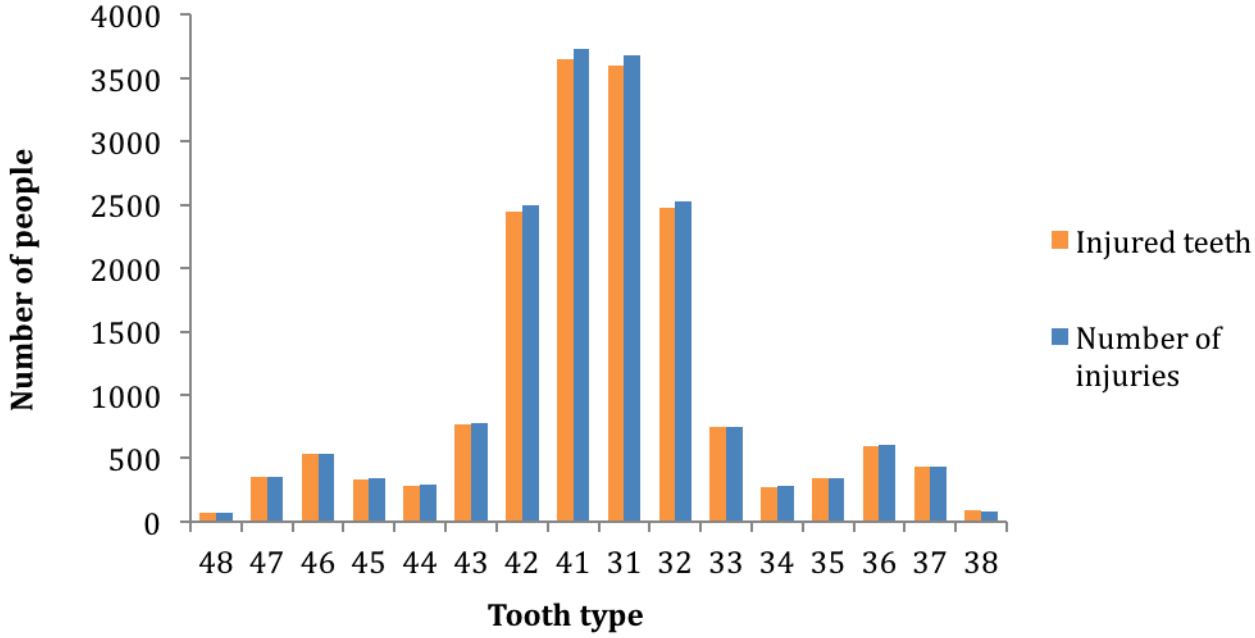

Figure 7. Absolute number of injured teeth and number of dental injuries among 32,110 people with orofacial trauma

More than one injury could be recorded for each traumatised tooth. Table 36 shows the total number of injuries registered for each tooth. Figure 5 and 6 illustrates the difference between the number of injured teeth and the number of injuries recorded. The difference was mainly seen in maxillary and mandibular anterior teeth. Data on dental injuries recorded for adults during the month of June 2008 are presented in the following section.

4.5 Descriptive analysis of ACC data (adults, June 2008)

Data on new dental injuries that occurred in June 2008 and were registered with ACC by a dentist or dental specialist are presented in this section.

Data on sociodemographic characteristics are presented in Table 48.

Table 48. Sex by other sociodemographic characteristics for 1,325 adults (18 years and older) who sustained dental injuries in June 2008 (percentages in parentheses; data are row percentage unless otherwise indicated)

	Sex		
	Female	Male	All combined[a]
Age group			
18-24	96 (28.3)	243 (71.7)[b]	339 (25.6)
25-34	107 (41.2)	153 (58.8)	260 (19.6)
35-44	141 (50.7)	137 (49.3)	278 (21.0)
45-54	111 (47.6)	122 (52.4)	233 (17.6)
55-64	53 (39.3)	82 (60.7)	135 (10.2)
65+	34 (42.5)	46 (57.5)	80 (6.0)
Ethnicity			
Māori	61 (40.1)	91 (59.9)	152 (11.5)
Pacific	7 (30.4)	16 (69.6)	23 (1.7)
Asian	16 (34.8)	30 (65.2)	46 (3.5)
European	413 (41.0)	594 (59.0)	1007 (76.0)
Other	26 (46.4)	30 (53.6)	56 (4.2)
Residual categories	19 (46.3)	22 (53.7)	41 (3.2)
All combined	542 (40.9)	783 (59.1)	1325 (100.0)

[a]Column percentage
[b]P<0.05

Some 1,325 adults aged 18 years and older registered a dental injury with ACC during the month of June 2008. There were more males than females (59% and 41% respectively). This was common in all age groups, except 35-44 years. The most frequent age was the 18-24 group, followed by 35-44 years. Europeans predominated, followed by Māori. Data on dental injury characteristics by tooth type are presented in Table 49 and 50.

Table 49. Absolute number of injuries among 1,325 adults who sustained dental trauma during June 2008, by tooth type

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Injury type																
Severe displacement	0	0	1	0	2	4	14	15	21	7	4	1	0	0	0	0
Displacement	0	1	0	1	3	5	19	28	39	14	5	3	2	2	1	0
Severe fracture	0	0	0	0	0	0	3	13	10	8	0	0	0	0	0	0
Fracture or loosening	0	3	16	18	12	15	57	194	189	67	19	18	14	18	7	1
Minor injury	0	10	16	16	17	77	206	384	366	223	87	23	26	22	20	3
All combined	0	14	33	35	34	184	299	634	625	319	115	45	42	82	28	4

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Injury type																
Minor injury	2	14	19	11	16	39	79	100	100	76	35	10	10	19	13	3
Fracture or loosening	0	17	22	11	2	2	11	12	17	12	4	4	12	22	11	3
Severe fracture	0	0	0	0	0	0	2	2	4	2	0	1	0	0	0	0
Displacement	1	0	2	0	0	2	6	13	9	7	3	0	0	1	0	0
Severe displacement	0	0	0	0	0	0	2	3	5	4	1	0	0	0	0	0
All combined	3	31	43	22	18	43	100	130	135	119	43	15	22	42	24	6

Table 50. Distribution of dental injury type for adults 18 years and older who sustained dental trauma in June 2008

	Dental injury	
	Frequency	Percent
Group		
Minor injury (concussion, enamel infraction, enamel fracture)	2042	64.9
Fracture or loosening (enamel-dentine fracture, subluxation, root fracture)	810	25.7
Severe fracture (complicated crown fracture, crown-root fracture)	45	1.4
Displacement (extrusive luxation, lateral luxation)	167	5.3
Severe displacement (avulsion, intrusive luxation)	84	2.7
All combined	3148	100.0

Overall, the maxillary teeth sustained more injuries than the mandibular teeth. Almost half of the injuries were incurred by the 11 and 21. The 31 and 41 were involved in almost 20% of injuries. Overall, *Minor injuries* were more common, followed by *Fracture or loosening* injuries and *Displacement* injuries. *Severe fracture* injuries were the least common. Data on the number of injured and treated teeth for dental trauma registered in June are presented in Tables 51 and 52.

Table 51. Injured and treated teeth for 1,325 adults who sustained dental trauma in June 2008 (absolute numbers)

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Injured	39	107	310	639	632	323	117	47
Treated	32	80	245	574	570	250	41	41

	Tooth type					
Mandible	43	42	41	31	32	33
Injured	44	104	132	137	101	44
Treated	32	79	102	107	77	35

Table 52. Percentage of treated teeth among 1,325 adults who sustained dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Treated	82.1	74.8	79.0	89.8	90.2	77.4	74.4	87.2

	Tooth type					
Mandible	43	42	41	31	32	33
Treated	72.7	76.0	77.3	78.1	76.2	79.5

Some 77.7% of injured teeth had treatment in the 5 years following dental trauma. Data on the number of treatments recorded by injury type are presented in Table 53 and Figures 8-9.

Table 53. Mean number of treatments recorded by injury type for 1,325 adults who sustained trauma during June 2008, by tooth type[a]

	Tooth type															
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Injury type																
Severe displacement	0.0	0.0	2.0	0.0	3.5	0.0	6.1	6.7	6.8	5.1	6.5	22.0	0.0	0.0	0.0	0.0
Displacement	0.0	3.0	0.0	10.0	3.0	0.0	5.6	6.3	5.1	6.0	2.6	11.3	18.0	7.0	17.0	0.0
Severe fracture	0.0	0.0	0.0	0.0	0.0	0.0	5.7	8.6	3.4	4.3	0.0	0.0	0.0	0.0	0.0	0.0
Fracture or loosening	0.0	4.0	4.1	3.7	4.3	4.3	4.9	5.0	5.0	4.7	4.7	4.9	4.6	4.7	3.7	3.0
Minor injury	0.0	1.9	2.2	2.6	2.2	1.6	2.5	3.3	2.9	2.2	2.1	3.1	3.8	3.1	2.3	1.0

	Tooth type															
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Injury type																
Minor injury	2.0	1.6	3.1	2.6	1.4	2.3	1.7	1.8	1.9	1.6	1.8	1.1	1.4	2.5	2.2	1.3
Fracture or loosening	0.0	3.9	4.1	3.5	3.0	3.5	3.6	3.0	5.1	4.4	4.3	2.3	3.3	3.8	3.2	2.0
Severe fracture	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0	3.8	2.0	0.0	4.0	0.0	0.0	0.0	0.0
Displacement	5.0	0.0	3.0	0.0	0.0	3.5	2.8	4.4	4.1	4.1	3.3	0.0	0.0	4.0	0.0	0.0
Severe displacement	0.0	0.0	0.0	0.0	0.0	0.0	3.0	6.3	5.0	4.8	6.0	0.0	0.0	0.0	0.0	0.0

[a] To be read in conjunction with Table 4

.

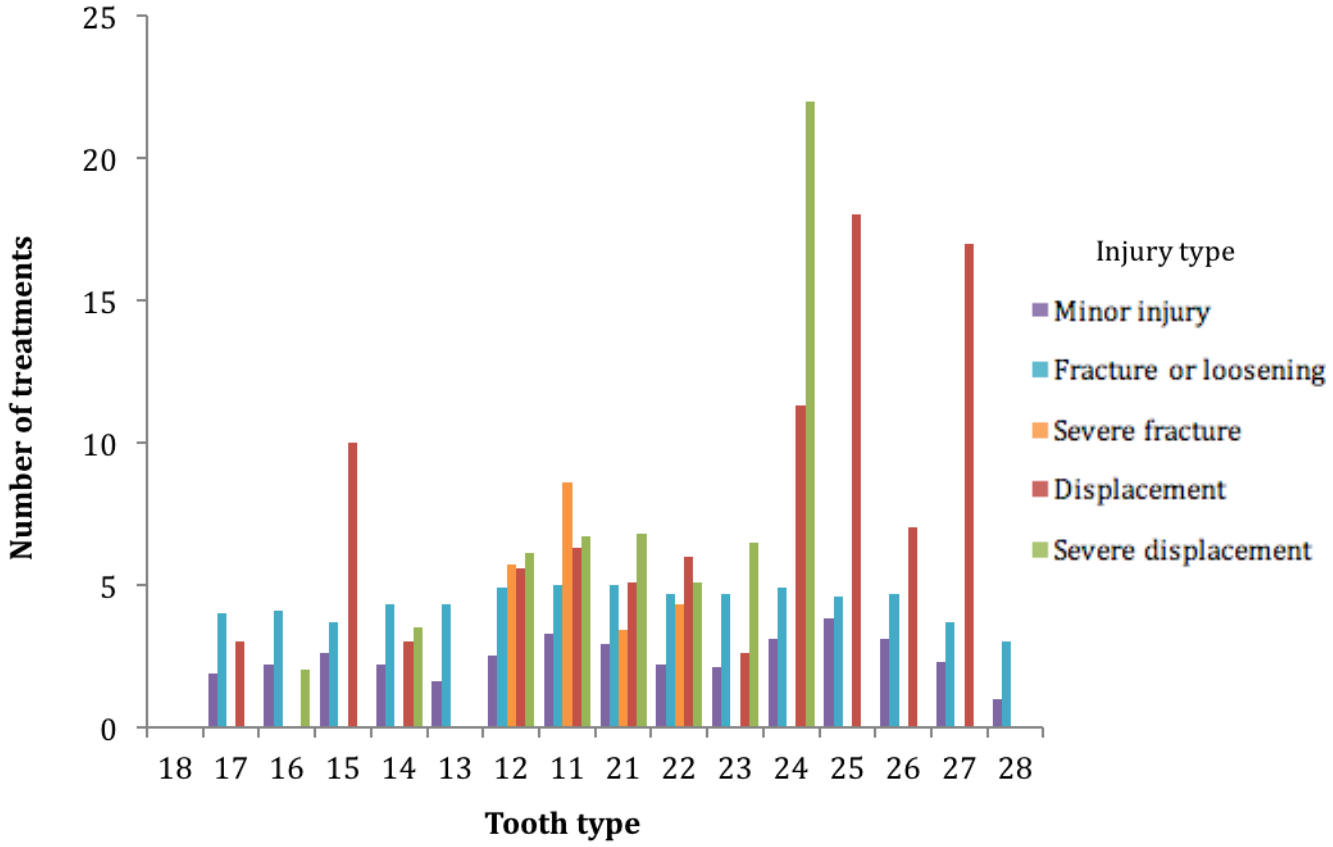

Figure 8. Mean number of treatments by injury type over 5 years, by tooth type

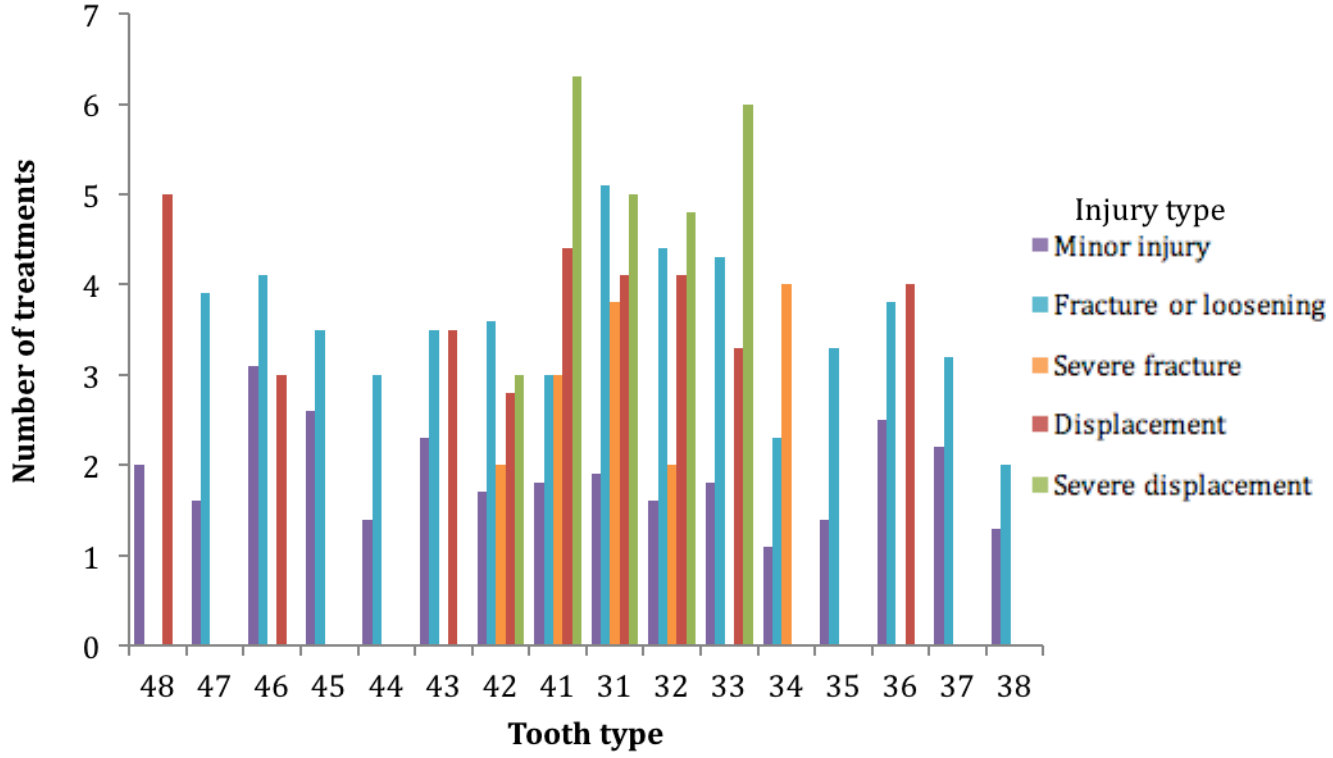

Figure 9. Mean number of treatments by injury type over 5 years, by tooth type.

The mean number of treatments for each injury type ranged from 1 to 18. There was a gradient observed by injury type, with generally more severe injuries requiring more treatments. Data on the number of root canal treatments, implants and extractions done in a 5-year follow-up period by tooth type are presented in Tables 54-56 and Figures 10-11.

Table 54. Absolute number of root canal fillings in a 5-year follow-up period for 1,325 adults who had dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Completed treatments[a]								
3	0	0	1	0	0	0	0	0
2	1	0	2	2	0	2	0	0
1	2	3	16	39	41	12	4	1
0	1322	1322	1306	1284	1284	1311	1321	1324

	Tooth type					
	43	42	41	31	32	33
Completed treatments[a]						
0	1325	1323	1325	1318	1321	1324
1	0	2	0	7	4	1

[a] All columns add up to 1,325

Table 55. Absolute number of implants placed in a 5-year follow-up period for 1,325 adults who had dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Completed treatments[a]								
2	0	0	0	1	0	0	0	0
1	0	0	4	7	5	1	0	2
0	1322	1325	1321	1317	1320	1324	1325	1323

	Tooth type					
Mandible	43	42	41	31	32	33
Completed treatments[a]						
0	1324	1324	1325	1325	1325	1325
1	1	1	0	0	0	0

[a] All columns add up to 1,325

Table 56. Absolute number of extractions in a 5-year follow-up period for 1,325 adults who had dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Completed treatments[a]								
2	1	0	2	5	9	1	0	0
1	3	3	15	16	15	17	3	3
0	1321	1322	1308	1304	1301	1307	1322	1322

	Tooth type					
Mandible	43	42	41	31	32	33
Completed treatments[a]						
0	1324	1323	1317	1324	1323	1324
1	1	2	7	1	2	1
2	0	0	1	0	0	0

[a] All columns add up to 1,325

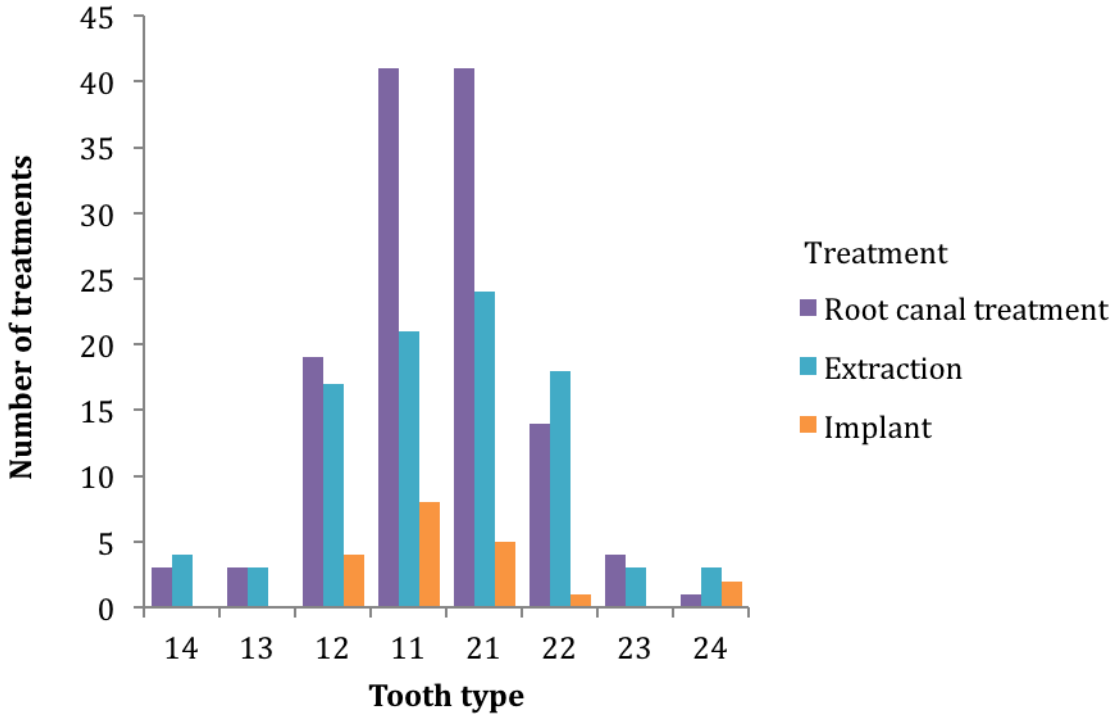

Figure 10. Absolute number of treatments for 1,325 adults who had dental trauma in June 2008, by tooth type (maxilla)

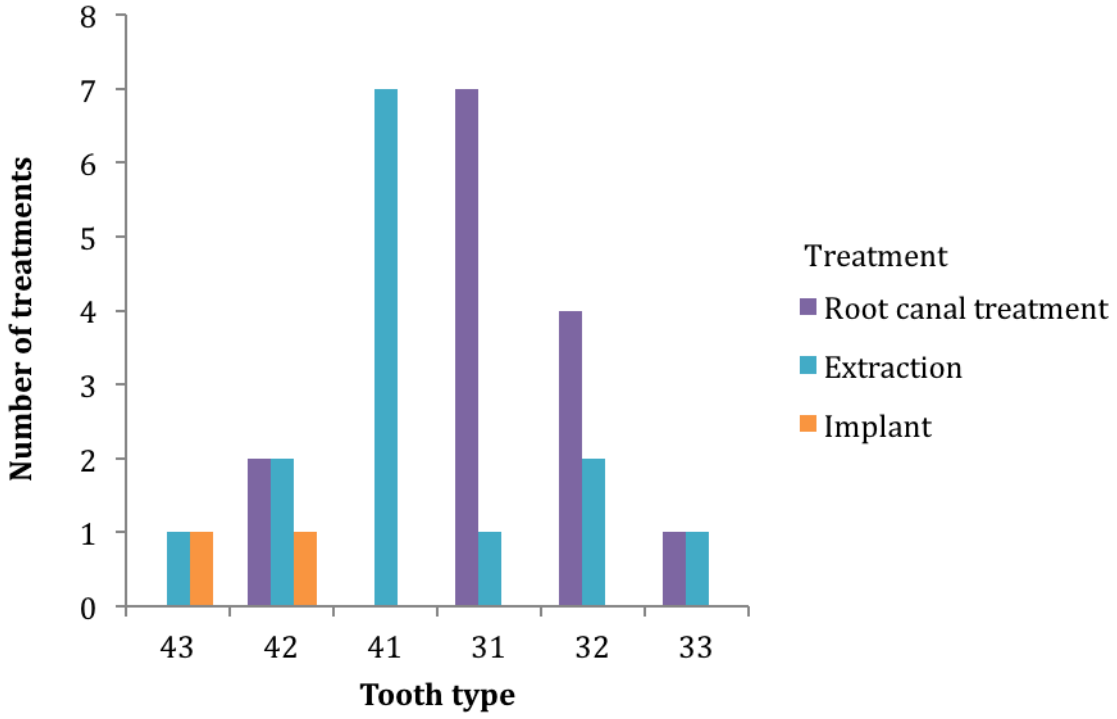

Figure 11. Absolute number of treatments for 1,325 adults who had dental trauma in June 2008, by tooth type (mandible)

The number of completed root canal treatments, implants placed and extractions that were provided during a 5-year follow-up period for teeth in injured in June 2008 were examined. Overall, more root canal treatments were provided than implants or extractions. Implants were infrequent, and those which were placed replaced mainly the maxillary central incisors. Data on the proportion of treatment in the 5-year follow-up that included root canal fillings, implants and extractions are presented in Tables 57-59 and Figures 12-27.

Table 57. Proportion (percentage) of treatment that included root canal fillings in a 5-year follow-up period for 1,325 adults who had dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Injury type								
Severe displacement	0.0	0.0	0.0	6.7	4.8	0.0	25.0	0.0
Displacement	0.0	40.0	15.8	17.9	20.5	14.3	0.0	0.0
Severe fracture	0.0	0.0	33.3	30.8	10.0	12.5	0.0	0.0
Fracture or loosening	16.6	6.7	8.8	6.2	8.5	12.0	10.5	5.6
Minor injury	5.9	0.0	5.8	5.7	4.6	2.2	3.4	4.3

	Tooth type					
Mandible	43	42	41	31	32	33
Injury type						
Minor injury	0.0	1.3	0.0	5.0	1.3	0.0
Fracture or loosening	0.0	9.1	0.0	5.9	16.7	25.0
Severe fracture	0.0	0.0	0.0	0.0	0.0	0.0
Displacement	0.0	0.0	0.0	0.0	0.0	0.0
Severe displacement	0.0	0.0	33.3	20.0	25.0	0.0

Table 58. Proportion (percentage) of treatment that included implant placement in a 5-year follow-up period for 1,325 adults who had dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Injury type								
Severe displacement	0.0	0.0	7.1	6.7	14.3	14.3	0.0	0.0
Displacement	0.0	0.0	0.0	7.1	0.0	0.0	0.0	33.3
Severe fracture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fracture or loosening	0.0	0.0	1.8	1.5	0.5	0.0	0.0	0.0
Minor injury	0.0	0.0	0.5	0.3	0.3	0.0	0.0	0.0

	Tooth type					
Mandible	43	42	41	31	32	33
Injury type						
Minor injury	2.6	0.0	0.0	0.0	0.0	0.0
Fracture or loosening	0.0	9.1	0.0	0.0	0.0	0.0
Severe fracture	0.0	0.0	0.0	0.0	0.0	0.0
Displacement	0.0	0.0	0.0	0.0	0.0	0.0
Severe displacement	0.0	0.0	0.0	0.0	0.0	0.0

Table 59. Proportion (percentage) of treatment that included extraction in a 5-year follow-up period for 1,325 adults who had dental trauma in June 2008, by tooth type

	Tooth type							
Maxilla	14	13	12	11	21	22	23	24
Injury type								
Severe displacement	50.0	25.0	42.9	26.7	23.8	28.6	25.0	100.0
Displacement	66.7	20.0	15.8	17.8	10.3	28.6	0.0	66.7
Severe fracture	0.0	0.0	0.0	15.4	0.0	0.0	0.0	0.0
Fracture or loosening	8.3	6.7	7.1	3.6	5.8	13.4	5.3	0.0
Minor injury	0.0	0.0	1.5	0.8	1.4	1.3	1.1	0.0

	Tooth type					
Mandible	43	42	41	31	32	33
Injury type						
Minor injury	2.6	0.0	1.0	0.0	0.0	0.0
Fracture or loosening	0.0	9.1	8.3	0.0	0.0	0.0
Severe fracture	0.0	0	50.0	0.0	0.0	0.0
Displacement	0.0	16.7	30.8	11.1	28.6	0.0
Severe displacement	0.0	0.0	0.0	0.0	0.0	0.0

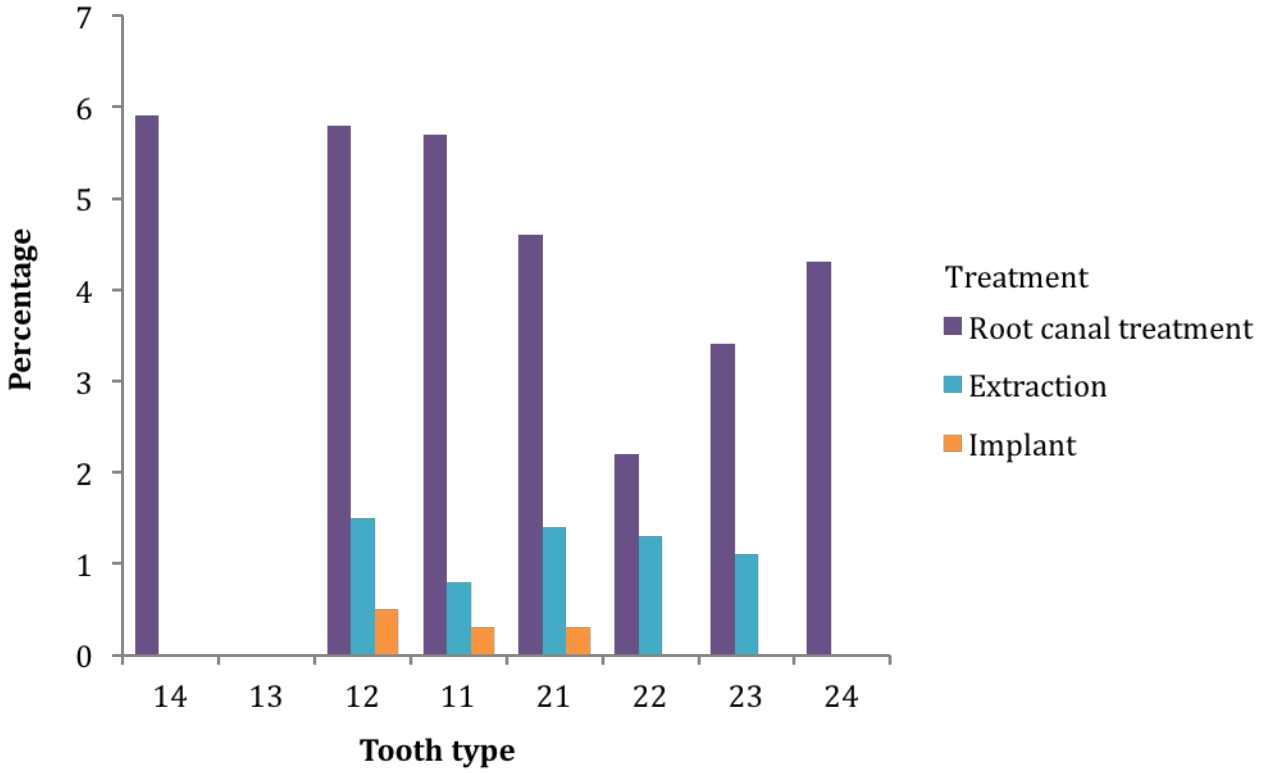

Figure 12. Proportion (percentage) of treatments for *Minor injuries* over 5 years, by tooth type (maxilla)

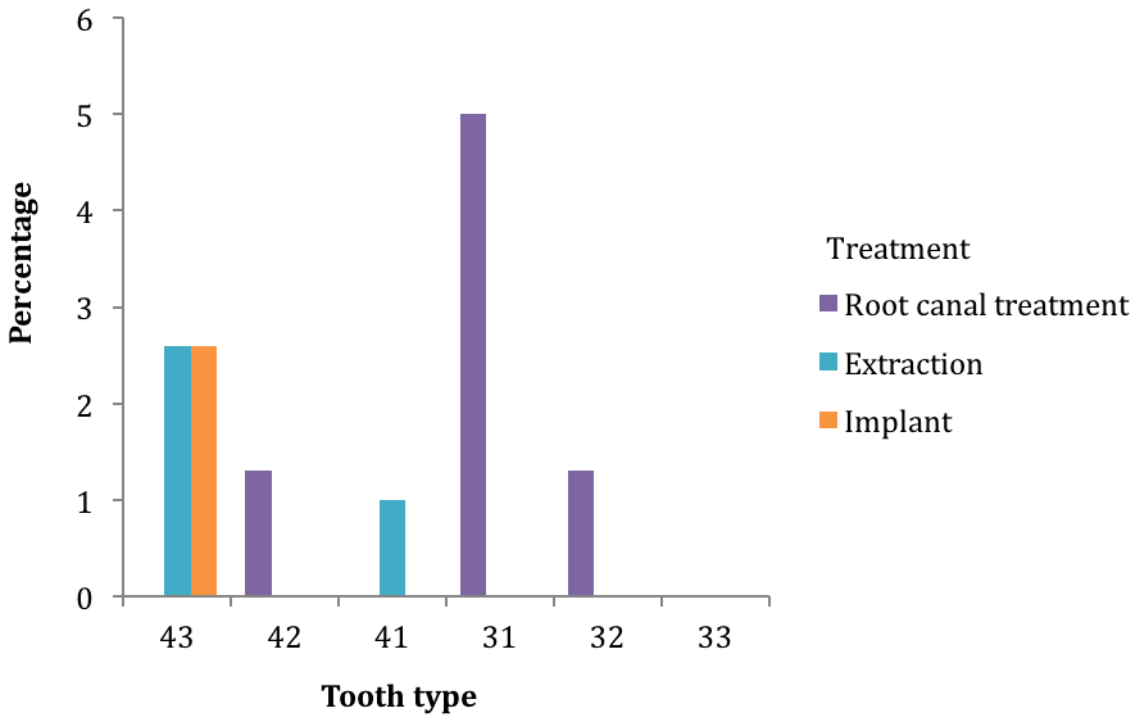

Figure 13. Proportion (percentage) of treatments for *Minor injuries* over 5 years, by tooth type (mandible)

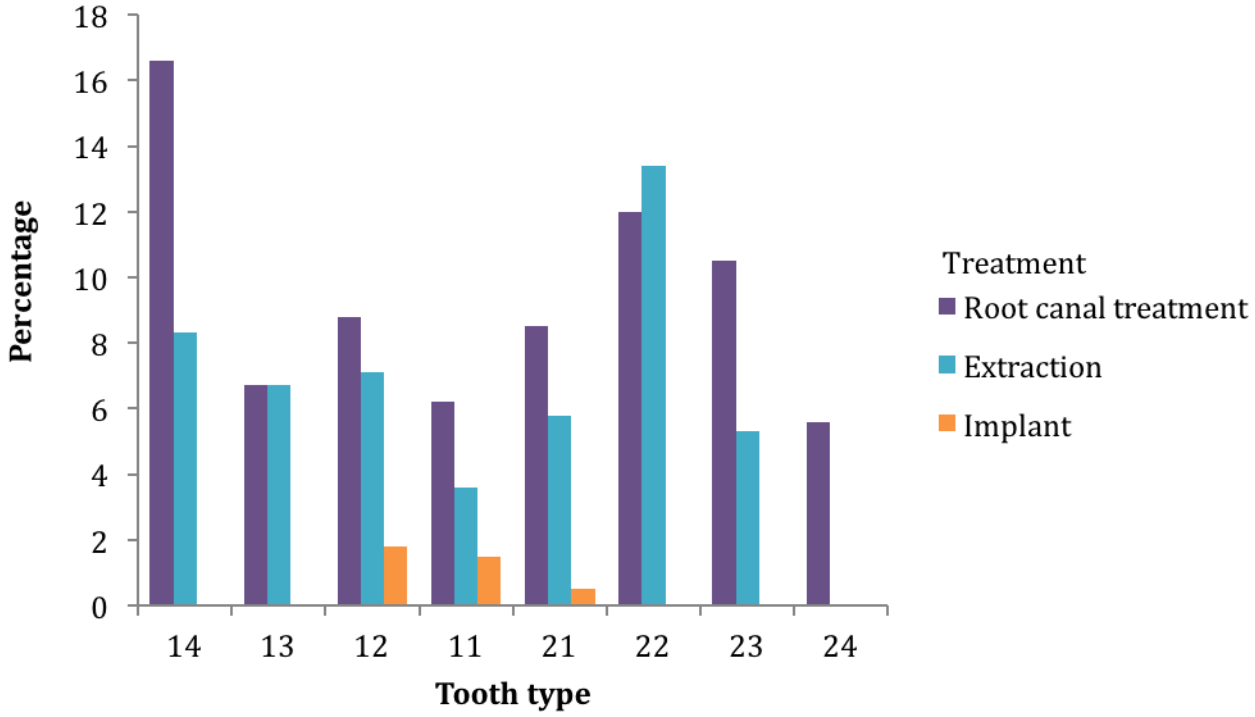

Figure 14. Proportion (percentage) of treatments for *Fracture or loosening* injuries over 5 years, by tooth type (maxilla)

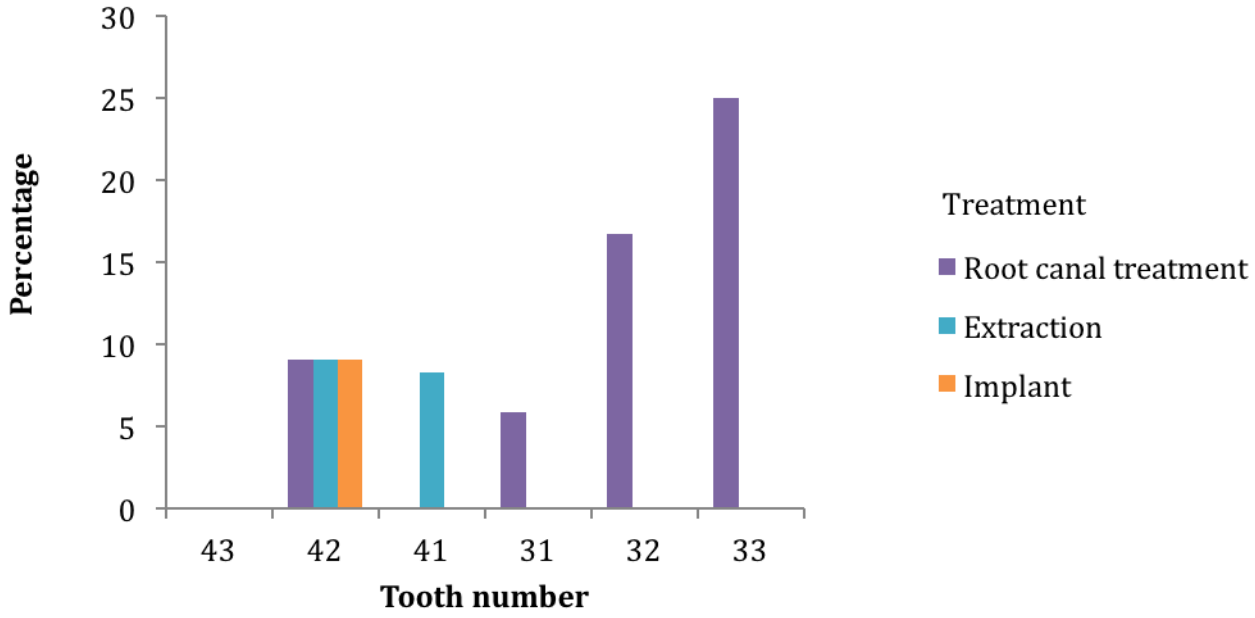

Figure 15. Proportion (percentage) of treatments for *Fracture or loosening* injuries over 5 years, by tooth type (mandible)

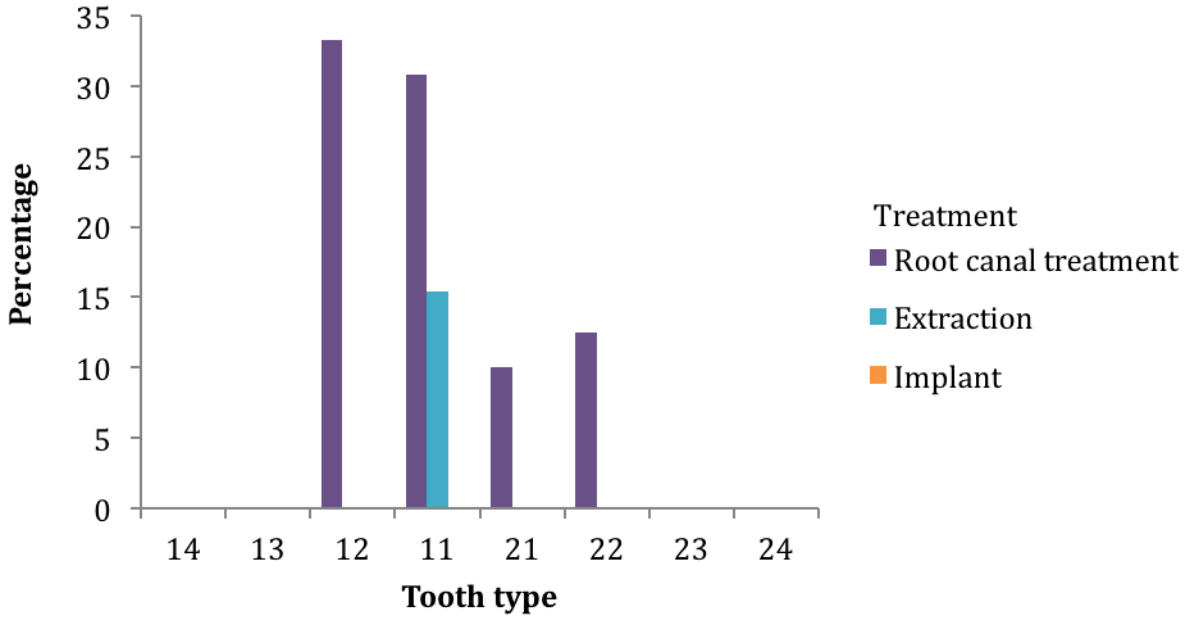

Figure 16. Proportion (percentage) of treatments for *Severe fracture* injuries over 5 years, by tooth type (maxilla)

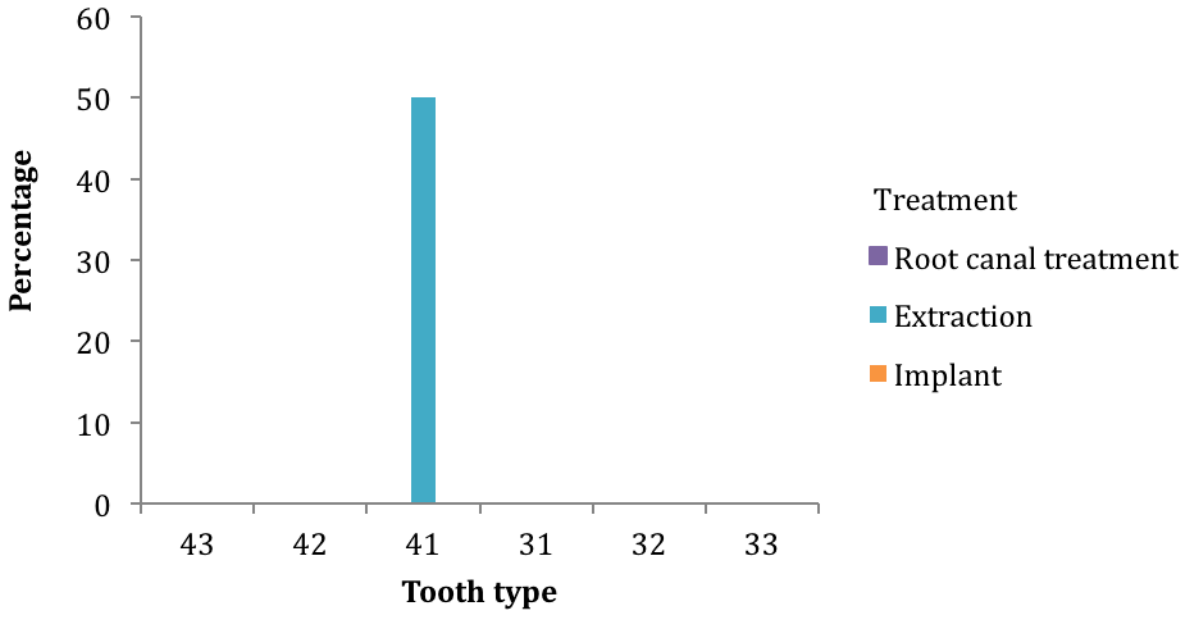

Figure 17. Proportion (percentage) of treatments for *Severe fracture* injuries over 5 years, by tooth type (mandible)

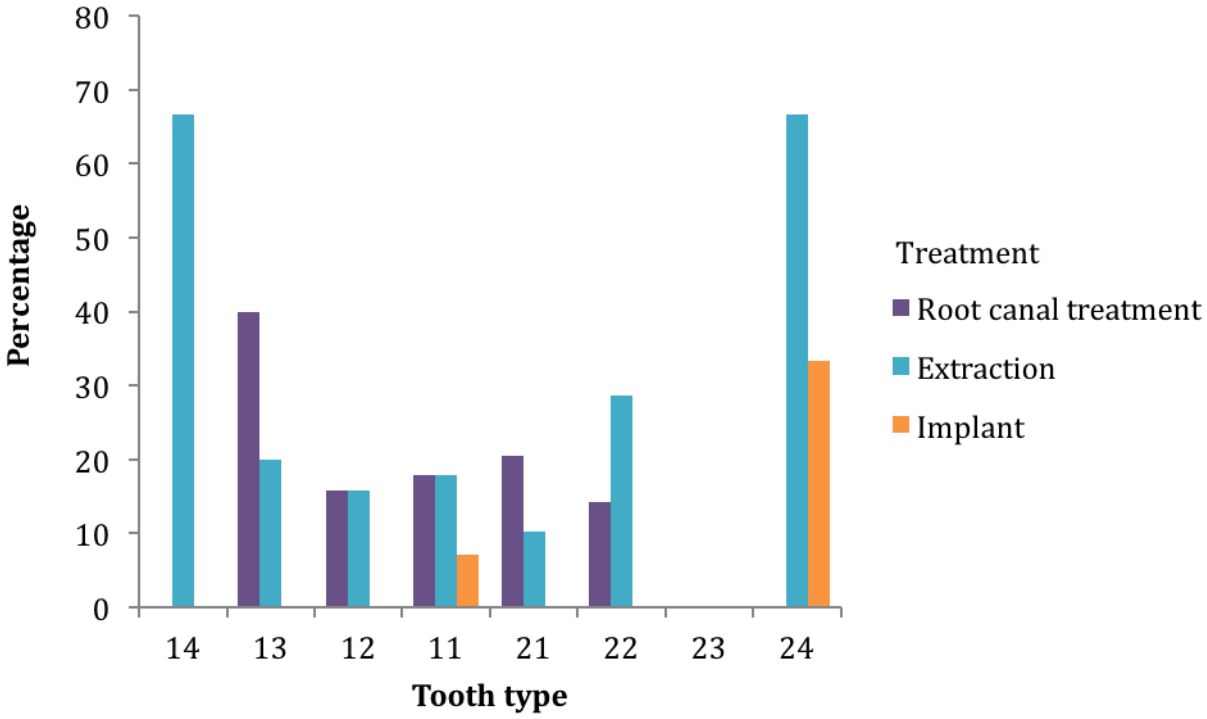

Figure 18. Proportion (percentage) of treatments for *Displacement* injuries over 5 years, by tooth type (maxilla)

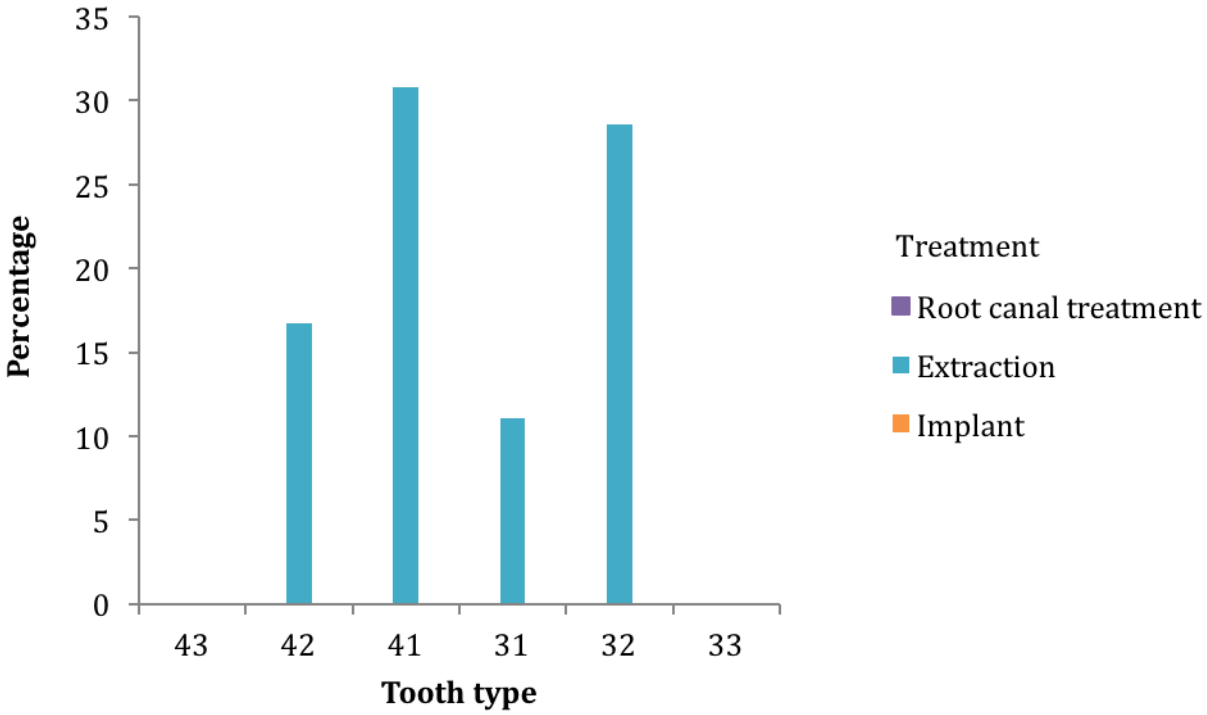

Figure 19. Proportion (percentage) of treatments for *Displacement* injuries over 5 years, by tooth type (mandible)

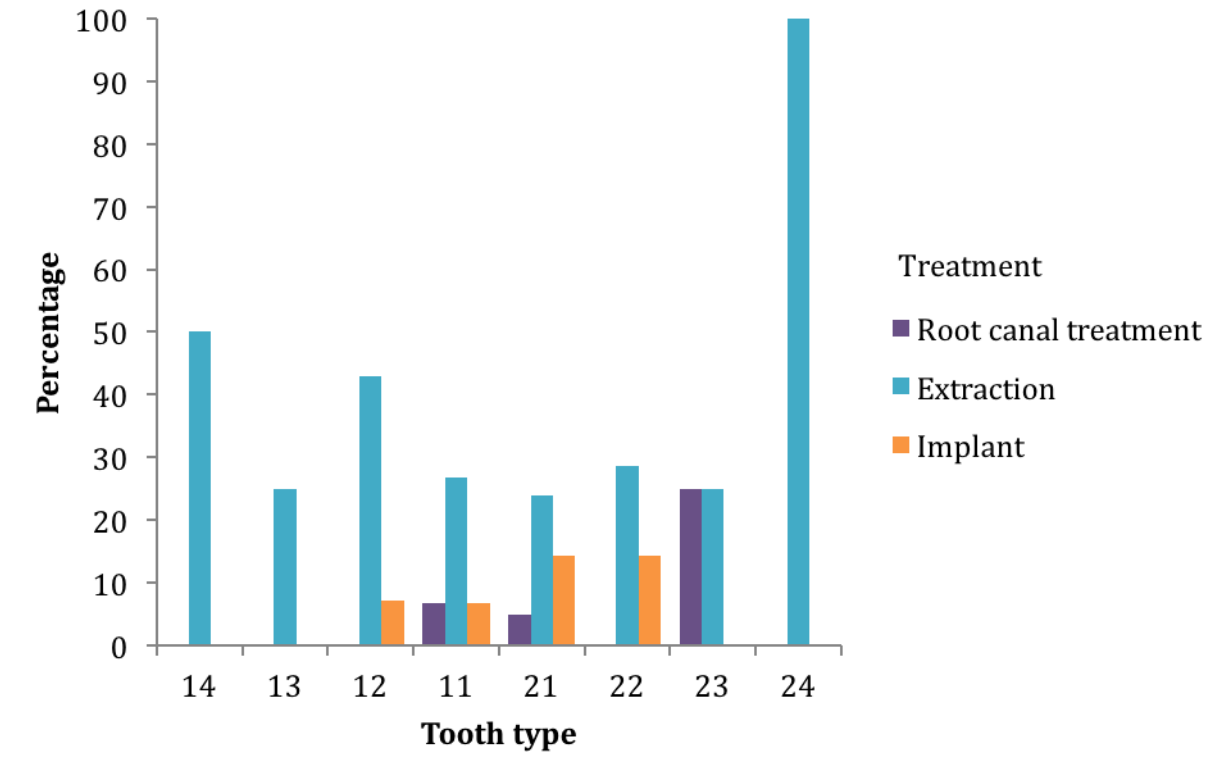

Figure 20. Proportion (percentage) of treatments for *Severe displacement* injuries over 5 years, by tooth type (maxilla)

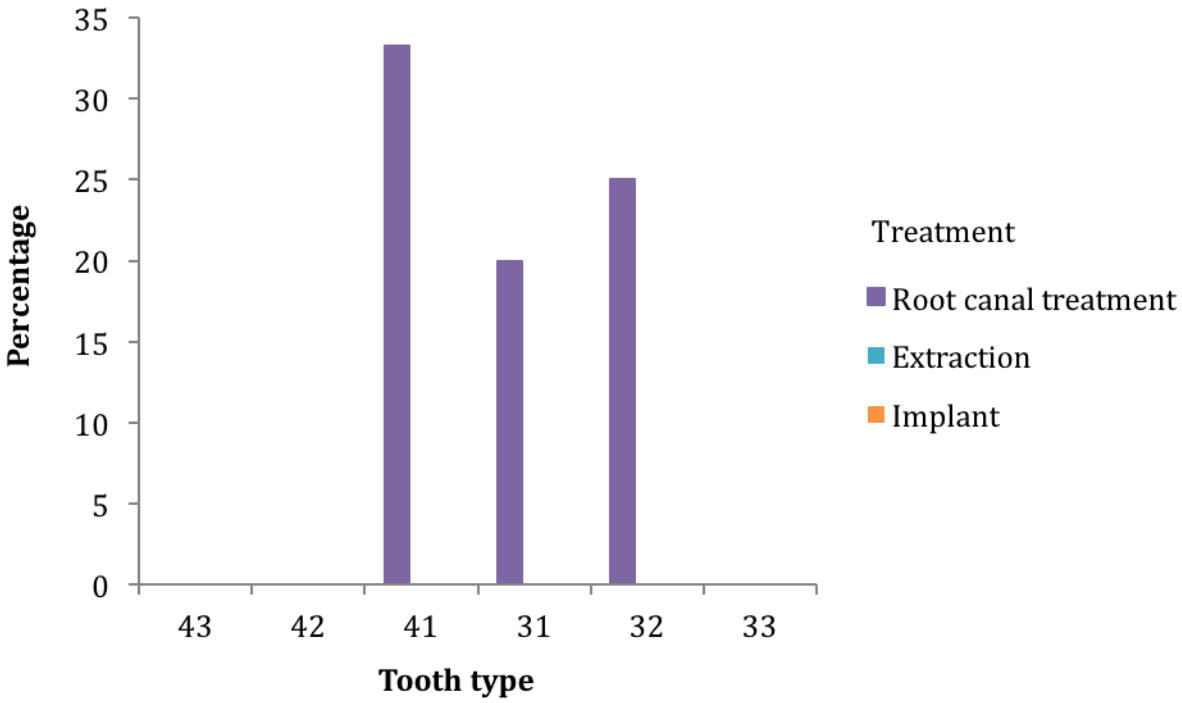

Figure 21. Proportion (percentage) of treatments for *Severe displacement* injuries over 5 years, by tooth type (mandible)

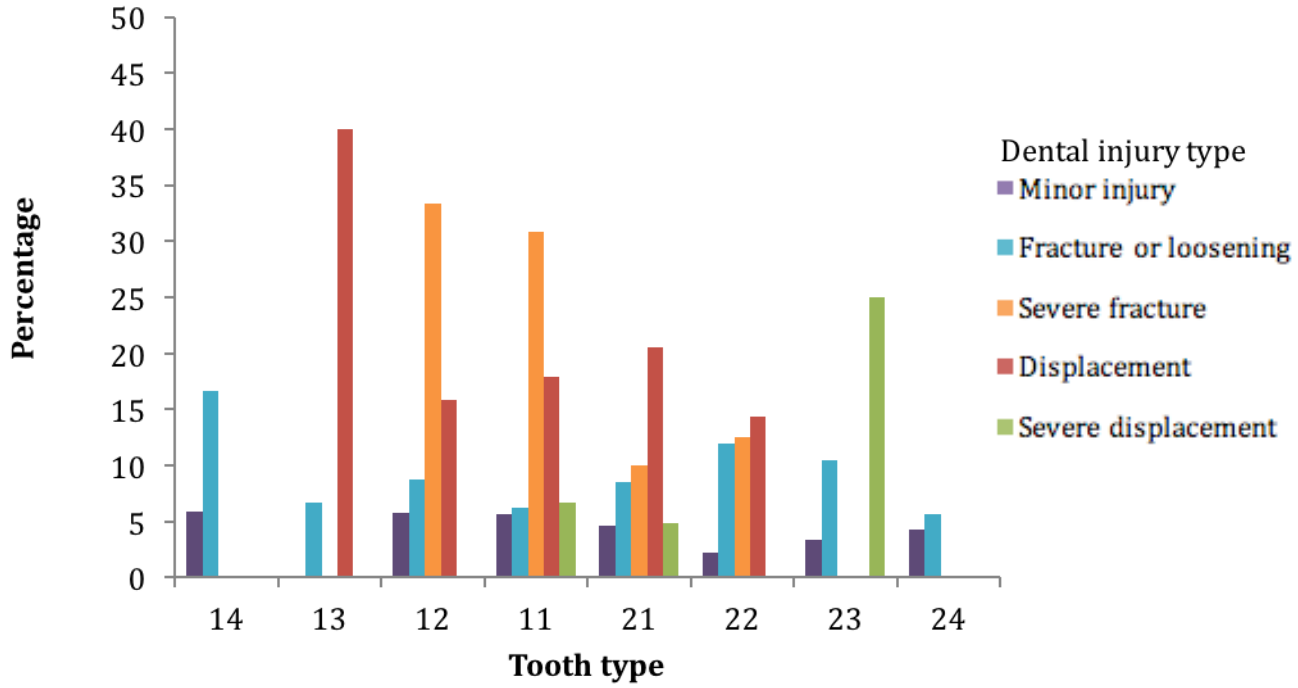

Figure 22. Proportion (percentage) of root canal treatments provided for each dental injury type, by tooth type (maxilla)

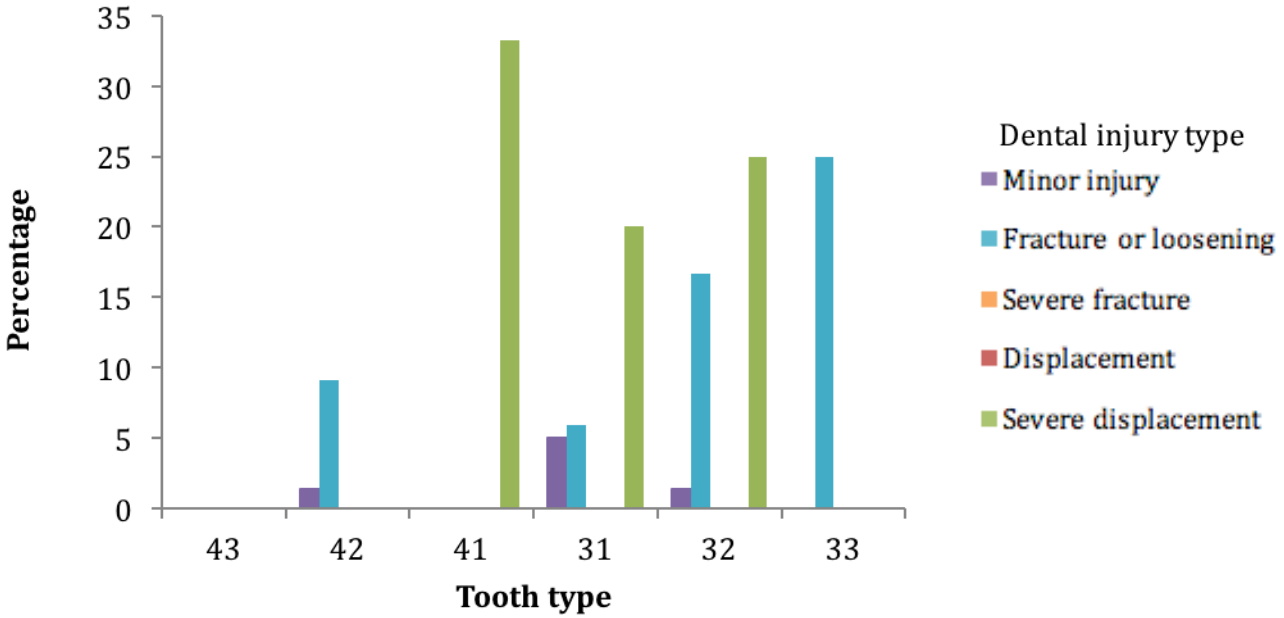

Figure 23. Proportion (percentage) of root canal treatments provided for each dental injury type, by tooth type (mandible)

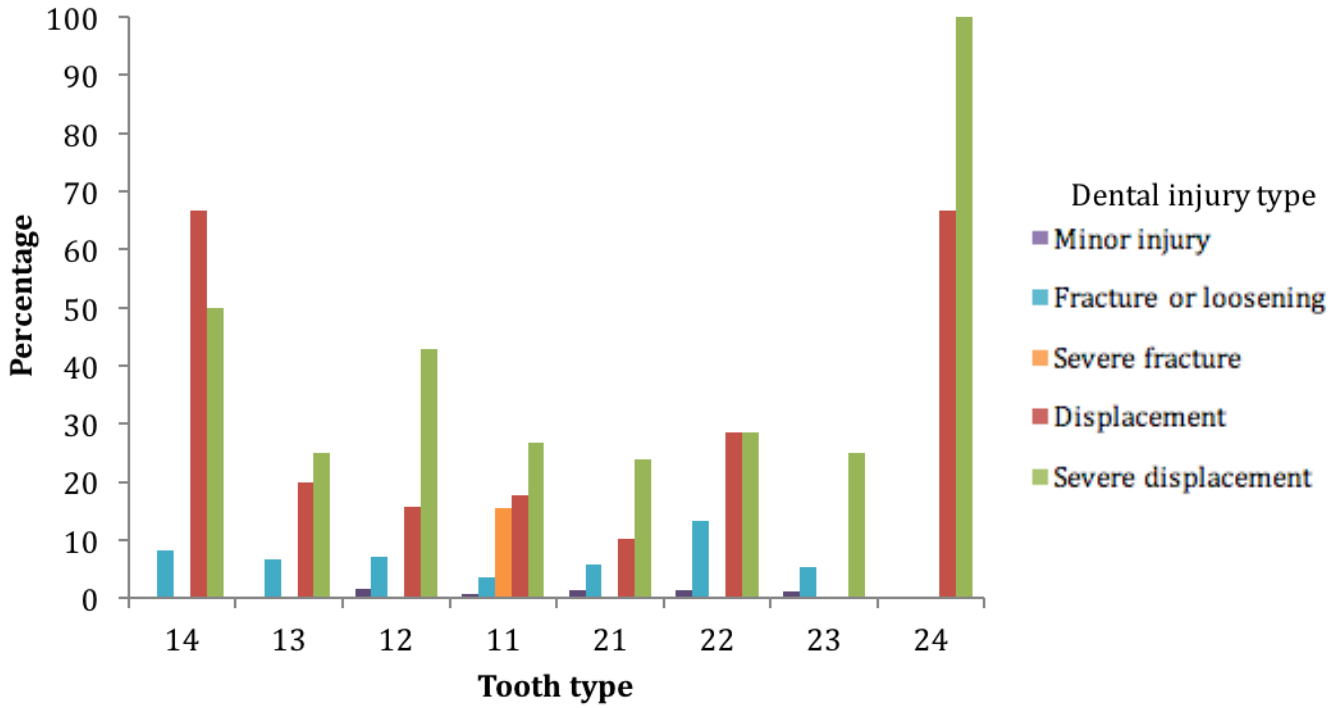

Figure 24. Proportion (percentage) of extractions provided for each dental injury type, by tooth type (maxilla)

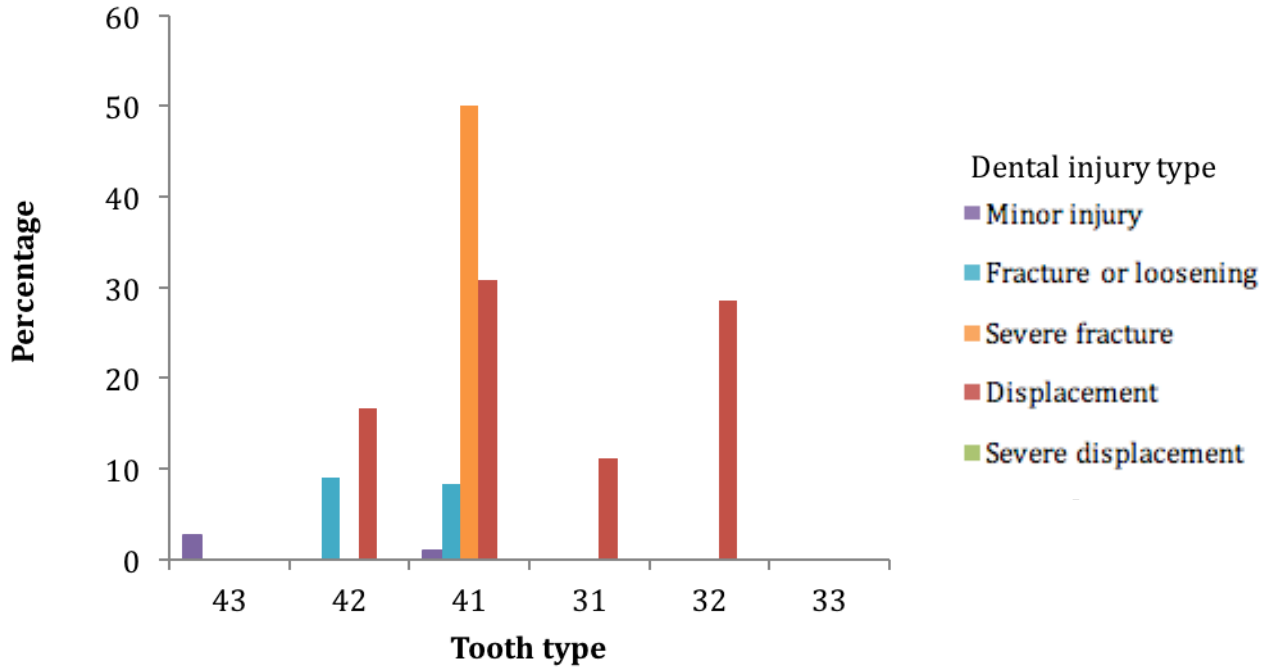

Figure 25. Proportion (percentage) of extractions provided for each dental injury type, by tooth type (mandible)

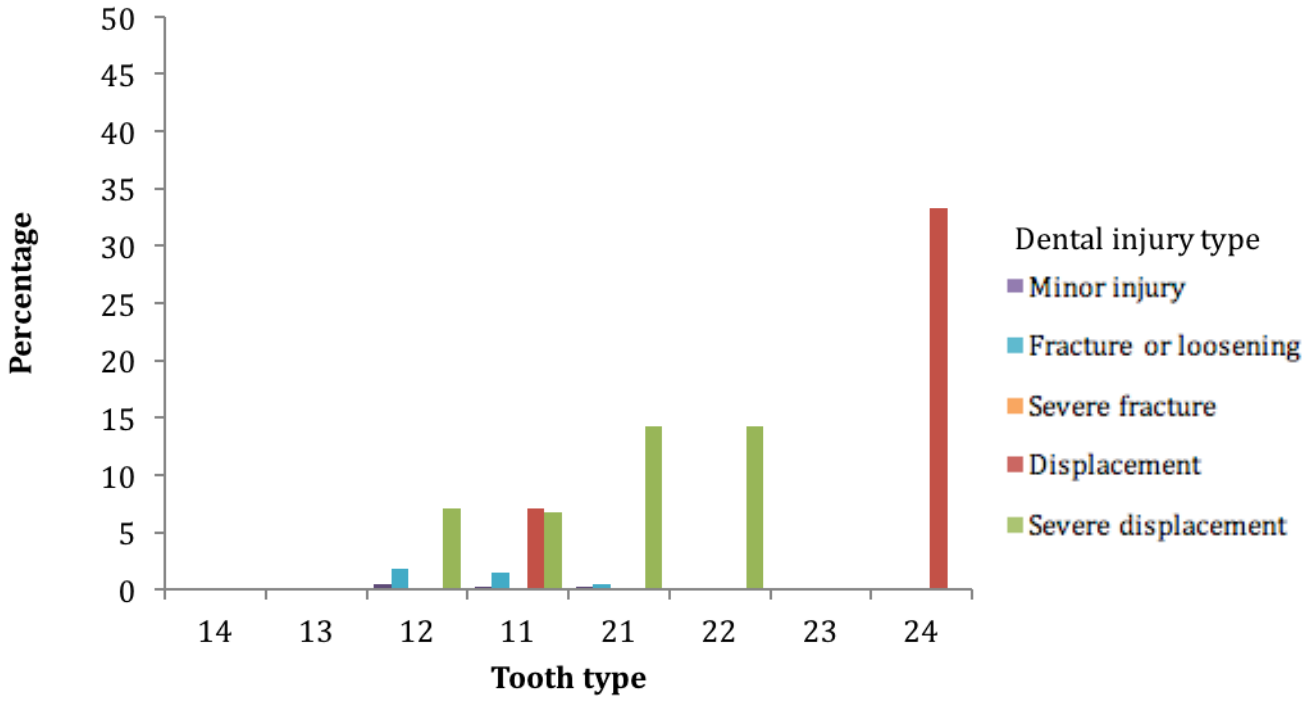

Figure 26. Proportion (percentage) of implants provided for each dental injury type, by tooth type (maxilla)

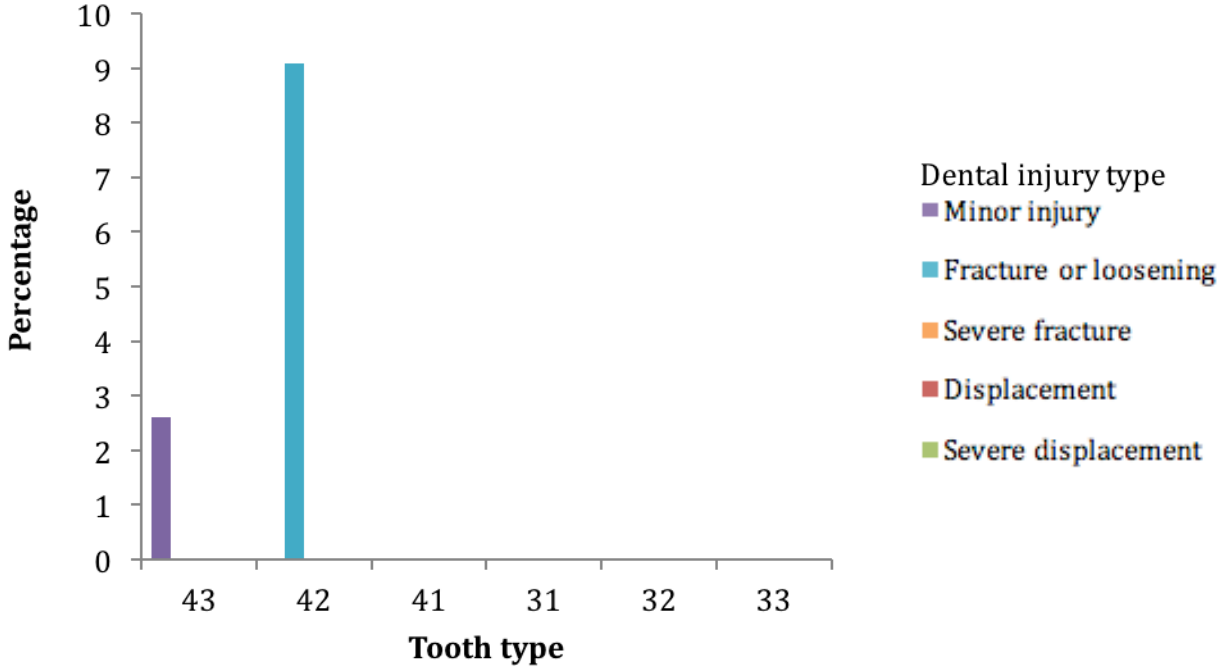

Figure 27. Proportion (percentage) of implants provided for each dental injury type, by tooth type (mandible)

Minor injuries (concussion, enamel infraction, enamel fracture) were associated with fewer root canal treatments, extractions or implants than the more severe injuries. *Minor injuries* tended to have more root canal treatment than implants or extractions. *Fracture or loosening* (enamel-dentine fracture, subluxation, root fracture) injuries had slightly more root canal treatment done, but almost an equal proportion of extractions and root canal treatment in the maxillary teeth. Root canal treatment was more common for *Severe fracture* injuries (complicated crown fracture, crown-root fracture) in the maxilla. Extractions were the most common of the three treatments for *Displacement* injuries (extrusive luxation, lateral luxation), especially for posterior maxillary teeth. *Severe displacement* injuries (avulsion, intrusive luxation) in maxillary teeth mainly resulted in extractions. However, *Severe displacement* injuries in the mandible had root canal treatment only. The largest proportion of implants provided in this 5-year period was for *Severe displacement* injuries.

Overall, the 13, 12 and 11 required the most root canal treatments, and this was a result of *Severe fracture* or *Displacement* injuries. In the maxilla, root canal treatment was mainly done for *Severe fracture* or *Displacement* injuries, followed by *Fracture or loosening* injuries, *Minor injuries* and *Severe Displacement* injuries. In the mandible, root canal treatment was mainly provided for *Severe Displacement* injuries, followed by *Fracture or loosening*.

Implants were mainly provided for *Displacement* and *Severe displacement* injuries in the maxilla.

Extractions in the maxilla were mainly provided for *Displacement* and *Severe displacement* injuries, especially in the premolars. Generally, *Severe displacement* injuries resulted in more implants than *Displacement* injuries. There was a small proportion of maxillary teeth that had extractions associated with *Minor*, *Fracture or loosening* and *Severe fracture* injuries. However, in the mandible, extractions were mainly provided for incisors with *Severe fracture* or *Displacement* injuries.

5 Discussion

The purpose of this research was to examine the prevalence, and associations and consequences of dental trauma in the New Zealand adult population, by analysing data from the 2009 NZOHS and the ACC. Both the self-reported and clinical estimates of dental trauma are similar to those from previous population-based studies carried out in other countries. The findings also showed that being male and aged 35-44 years are risk markers for clinical signs of dental trauma, while being older than 35 years was a risk marker for self-reported dental trauma. Risk markers for orofacial trauma (which could include damage to teeth) were being male, Māori or European/other or being 35-54 years old. Analysis of dental information from the ACC revealed that 32,110 adults and children sought treatment for orofacial trauma during 2008. Dental injuries to permanent teeth most commonly involved the central and lateral maxillary incisors. The 1,325 adults who sustained dental trauma during June 2008 were followed for the subsequent five years. Generally, more severe injuries required more treatment.

5.5 Weaknesses

Before discussing the findings, it is appropriate to reflect on the weaknesses and strengths of this study. The weaknesses include aspects of the study design, data collection and the generalisability of particular findings.

5.5.1 Study design

This was a retrospective analysis of two distinct datasets, each of which was analysed separately. The first was from a national cross-sectional survey. The second was a consecutive case series from the compulsory social insurance scheme, the ACC. Both datasets consisted of two parts. The NZOHS dataset contained information from a questionnaire and a clinical examination. The ACC dataset contained both injury and treatment information. The study design weaknesses will be discussed in the following paragraphs.

Cross-sectional studies are used to determine the prevalence of a health condition (outcome), as well as investigating associations between putative risk factors and the condition. Cross-sectional studies, or surveys, are a time- and cost-effective method for collecting a large quantity of information. However, their main limitation is that the data are collected at one specific point in time, and therefore do not indicate the sequence of events. Hence, causality is not able to be determined. There is a risk that, at a different time point, another cross-sectional study may provide different findings.

Although implemented to a high epidemiological standard, the NZOHS trauma examination was restricted to the six permanent maxillary anterior teeth. Most studies of dental trauma have revealed the maxillary central incisors to be the most commonly affected teeth, followed by the maxillary lateral incisors. Findings from the ACC data suggest that trauma to the maxillary canines may be less common than that to the mandibular incisors. While the choice of teeth included in the examination would have been dictated by time and cost, future surveys should extend the trauma examination to include the mandibular incisors as well.

The unique clinical classification used in the NZOHS survey made it difficult to compare the findings to those from other studies. This is not a new problem, and it has been discussed in previous papers (Feliciano and de Franca Caldas 2006; Andersson and Andreasen 2011). The NZOHS examination used a classification that was similar to the one used in the NHANES III (Apppendix II) and also to one illustrated in the chapter authored by Glendor et al. (2007) which was in turn described as being similar to the 1970 classification by Ellis and Davey (1970). It was not clear from the methods description how this classification was derived. It may have been developed to be better adapted for a clinical epidemiological study, by removing observations such as “pulpal exposure”, which would have been impossible to determine. The most common trauma observation (“treated trauma”) was a very broad observation that included treatment of any size and involvement. This description could cover any injury, ranging from a minor enamel fracture to a complicated crown-root fracture, both of which differ greatly in both management and prognosis. There was no scope with this classification to

record trauma-associated pathology such as a draining sinus or abscess, in contrast to classifications such as the one used for the NHANES III. However, similarly to the NHANES III classification, it did include observations such as discolouration, which could indicate a treatment outcome (root canal treatment) or untreated complication of trauma (a necrotic untreated tooth). Without including the extra information on such an observation, these conditions may not be distinguished from each other. Another key difference between the NZOHS classification and the NHANES III is that the latter included a code for the presence of a palatal or lingual resin restoration, suggesting likely root canal treatment. Recording treatment is a key difference between a classification used for epidemiological purposes (which is used to generate estimates of the prevalence and severity of a given state) and a clinical classification, which is used to record injuries as they present.

The NZOHS examination classification was also ambiguous. The criteria included an observation of "avulsed, luxated because of trauma, verified by participant". It is not clear whether that observation included all periodontal injuries (concussion, subluxation, lateral luxation, extrusion, intrusion, avulsion) recalled by the participant or whether it included only injuries that involved displacement (lateral luxation, extrusion, intrusion, avulsion). The methodology report did not include instructions for asking patients about previous injuries during the examination, and so this would not have been standardised to ensure consistency among examiners.

It is not possible to accurately estimate the prevalence of all types of dental trauma from a cross-sectional survey. It is likely that periodontal ligament injuries—such as concussion and subluxation—would be under-reported, due to their more minor nature, along with participants being less likely to recall them. More serious trauma—such as root fractures and previous luxation injuries—may also have not have been reported. This is because the displaced teeth may have been repositioned successfully, and the tooth may have appeared clinically normal. Complications particular to these injuries (such as a non-healing root fracture or root resorption) are often not visible clinically, and their diagnosis usually requires radiographs. As is common with other large oral health surveys,

radiographs were not taken for the 2009 NZOHS. Examiners attempted to mitigate the potential under-reporting by verifying trauma with the participant.

The trauma classification used in the NZOHS questionnaire was also a non-standard one. Lay terminology was used; for instance, "chipped" and "broken" were used rather than "enamel-dentine fracture". This classification does make it hard to make comparisons with the clinical examination data, but it is, however, similar to other studies (Locker 2007). The use of colloquial language would have made it more understandable for the general public.

The NZOHS questionnaire did not include questions on the age at which the orofacial trauma had occurred. Thus, previous self-reported dental trauma could have occurred to either the primary or permanent teeth. This is in contrast to the survey by Locker (2007). It could be one explanation for the difference between the self-reported dental trauma and the clinically observed dental trauma estimates (28% and 23% respectively).

The ACC dataset contained treatment information associated with dental injuries that occurred in June 2008, over a period of 5 years. The purpose of analysing this information was to gain some insight into the outcomes of particular types of injuries. This type of dental information from ACC had not been analysed before. The size of the dataset was large and contained a vast amount of information, and extracting it from the ACC database was not straightforward. The year 2008 was selected because it was close in timing to the 2009 NZOHS. The month of June was chosen to provide a small sample to test this analysis, and it was anticipated that one month would provide enough treatment data. However, there were no prior findings on which to base this prediction, and some of the treatment information for mandibular teeth consisted of very small numbers. June was chosen to include winter sports, such as rugby and basketball. Studies have shown that winter sports contribute to a significant proportion of dental injuries registered with the ACC (Love et al. 1998; Welch et al. 2010). It is therefore possible that more dental injuries occurred in June than in other months during 2008. Further and more extensive analysis of the outcomes of particular types of dental trauma recorded

with the ACC could be done, but it would involve considerably more programming.

5.5.2 Data collection

There were a number of data collection weaknesses; these included recall bias, inaccuracies with recording, and over-reporting and under-reporting. Recall bias is an error caused by differences in the accuracy of the recollections of study participants. It could have affected both the questionnaire and clinical data in the NZOHS.

Recall bias is one of the main limitations of using a questionnaire. Some 80% of participants reported that their orofacial trauma had occurred more than five years previously, and so there could have been many who did not remember or did not recall the injury accurately. In addition, the questionnaire was not limited to trauma to permanent teeth. Other studies have attempted to mitigate this by asking participants about what age they remember having the trauma (Locker 2007).

The clinical examination approach was ambiguous with respect to participant verification of dental trauma, and it is possible that an element of recall bias could have been introduced. The examiners asked participants about any history of trauma to their upper front teeth before clinically assessing those for visual signs of trauma. A code of avulsion or luxation was assigned if verified by the participant. It is not clear how much this code depended on that participant's recall. For instance, if an examiner thought that a tooth had probably been injured but the participant could not recall any trauma, would it have been recorded as trauma? Similarly, if a participant recalled a luxation but there was not anything clinically apparent, as would often be the case, would it be recorded as trauma? Patients may also have recalled injuries to teeth other than the six maxillary anterior ones, or injuries to the primary dentition.

Inaccuracies in diagnosis and data recording were more likely in the ACC dataset. The NZOHS data recording was carried out to a high standard. However, although the reliability for most aspects of the dental examination was determined for 19

of the 21 examiners[9], consistency among trauma examinations using the NZOHS classification was not tested. Interviewers and recorders for the NZOHS entered participants' responses and clinical information straight on to a laptop computer, which would have limited the amount of error that could occur.

Inaccuracies with recording could have occurred with the ACC data collection at three different stages. The dentist may have inaccurately diagnosed the injury or recorded it incorrectly on the ACC42 form. Information from the ACC42 is then manually entered onto a computer database at the ACC, a stage which could also introduce error. In addition to this potential error, it is also common practice (and clinically prudent) when recording an injury for ACC to record the teeth on either side of an obviously damaged tooth as having been concussed, whether or not the presentation or symptoms suggest this. Anecdotal evidence suggests that clinicians tend to over-report dental injuries to ACC, lest a future claim for treatment is turned down. Unfortunately, this could result in over-reporting of concussion, and perhaps other injuries as well. This is supported by the findings of Love and Ponnambalam (2008), who found concussion to be the most common dental injury recorded at the University of Otago School of Dentistry from 2000 to 2004. The authors suggested this was probably due to the precautionary practice of reporting teeth either side of the obviously injured tooth as having been concussed (Love and Ponnambalam 2008).

The risk of over-reporting is not confined to the ACC dataset. Enamel trauma that had not been treated may have been over-reported in the clinical examination of the NZOHS. This is because chipping of the incisal edge from non-accidental causes (such as bruxism) may have been incorrectly recorded as dental trauma. As discussed above, it is not clear from the 2009 NZOHS methodology report whether the examiner would rely on the participant's recollection of previous trauma in such instances.

[9] One examiner who carried out only three examinations was excluded; one set of replication records were lost

Under-reporting could have also occurred with the NZOHS clinical data. Since most participants (80%) reported that their dental trauma had occurred more than five years prior to the survey, it is likely that some would have had subsequent dental treatment on these teeth for reasons besides trauma. For instance, a composite restoration repairing an enamel and dentine fracture could require replacement with a larger restoration following secondary caries, which could make an observation of the extent or nature of previous trauma difficult to determine. Indirect restorations (such as crowns) may have been placed, and these could also mask the original injury. The examiners attempted to mitigate this by asking participants about a history of dental trauma during the examination.

5.5.3 Data analysis

There was the potential for error to be introduced during the analysis of the ACC data. As discussed earlier, multiple variables (multiple injury classifications, multiple treatments over multiple dates) associated with each tooth of each new injury claim meant that the data had to be re-categorised for the purposes of this analysis. Consequently, some of the richness and complexity of the data would have been lost in the interests of rendering a usable picture. However, the purpose of using this dataset was to support the findings from the NZOHS, and further investigations in greater detail could be done at a later stage. The 12 injuries were arranged into five categories in order of severity. This was a classification developed for the purposes of the study. The order was based on current evidence on dental trauma outcomes for permanent teeth (Andreasen et al. 2007). It provided a simple way to compare the seriousness of injuries, and it also limited the number of teeth with more than one injury classification. It was used for the first time in this analysis and appears to have functioned satisfactorily. Without this rationalised categorisation, the dataset would have been too complex to analyse for this study.

The categories (*Minor injury, Fracture or loosening, Severe fracture, Displacement and Severe displacement*) were based on the probable impact of an injury and likely survival of the tooth. They were designed to be applied to mature

permanent teeth for the purposes of this study, and did not take into consideration the effects of delayed treatment, or treatment not in accordance with current trauma treatment guidelines. A rationale based on the literature follows (Andreasen et al. 2007). *Minor injuries* (concussion, enamel infraction, enamel fracture) require no or minimal treatment and have a good long-term prognosis with a low risk of complications. *Fracture or loosening* injuries (enamel-dentine fracture, subluxation, root fracture) can require minor to moderate restorative treatment or splinting. A small proportion of teeth may develop pulp necrosis later on. However, "root fracture" can encompass a range of injuries, and prognosis can depend on displacement of the coronal fragment. For the purposes of this study, it was presumed that the coronal fragment was not displaced, and favourable healing could occur. *Severe fracture* injuries (complicated crown fracture, crown-root fracture) require more complex restorative treatment and have a higher chance of pulp necrosis. *Displacement* injuries (extrusive luxation, lateral luxation) involve damage to the pulp and periodontal ligament and require splinting and monitoring. These injuries have a reasonable chance of complications, including pulp necrosis and/or root resorption. *Severe displacement* injuries (avulsion, intrusive luxation) represent the most severe injuries, also involving the pulp and periodontal ligament. The blood supply to the pulp is lost and the risk of root resorption is high. The prognosis of teeth with these injuries is often poor, and complex treatment is needed. Injured teeth could have multiple diagnoses from the same category (for instance, concussion and enamel fracture) or different categories (for instance, subluxation and complicated crown fracture), although this was not as common after reorganisation into the five groups. Due to the complex nature of the data the outcomes—that is, treatment done—were not able to be determined for combination injuries, such as *Fracture or loosening* injuries and *Severe fracture* injuries occurring together.

For the purposes of this study, only ACC treatment involving completed root canal treatment, extractions or implants was examined. In some cases, multiple root canal treatments or extractions occurred for an injured tooth. There are several possible reasons for this observation. The code for completed root canal

treatment is "per canal filled", so that it is possible that two canals would have been treated on maxillary first premolars. The root canal treatment may have needed to have been re-done (root canal re-treatment) within that five-year period, and so it would have been claimed for twice. Similarly, extractions may need to have been carried out over multiple appointments by different clinicians. The situation could arise where a dentist extracted a tooth but a root fracture prevented removal of a root fragment, with the patient subsequently referred to an oral surgeon. Since (for this study) the term "extraction" included ACC invoice codes for extraction and surgical extraction, this would account for multiple extractions being coded for some teeth. Finally, the same treatment occurring multiple times could, of course, be due to error in recording.

All 82 ACC treatment codes were included in this analysis (Accident Compensation Corporation 2016). The 82 codes include radiographs and periodic examinations. Although such codes do not indicate an intervening treatment per se, they are still an indication of on-going dental appointments and contribute to the overall cost of a dental injury.

5.5.4 Generalisability

The ACC dataset suffered from a "floating numerator" problem. This error occurs when the number of cases are not directly able to be related to a population at risk. In other words, direct inferences cannot be made about a source population, because the data are absolute numbers rather than rates that reflect the population at risk. However, we do know that, after decades of the ACC system, the assumption can safely be made that the cases reflect virtually all cases of dental trauma requiring treatment during that particular year. The purpose of the ACC findings was to support the national survey findings, and to also provide some insight into the burden to society from dental trauma.

5.6 Strengths of the study

This is the first study to examine dental trauma of NZ adults at a population level. It is unique because it utilised two broad datasets, the NZOHS and the ACC one. Hence, it provided the first opportunity to examine adult dental trauma at this level. Furthermore, the NZOHS dataset contains both clinical and self-reported information.

5.6.1 Sample size and response rate

The NZOHS sample was large and representative of the adult New Zealand population. The weighted adult response rate for the 2009 NZOHS was 70% for the interview, and 84% for the examination, which exceeded the NZ health survey aim of 70% (Ministry of Health 2010a). However, because the 2009 NZOHS was based on the sampling frame of the NZHS 2006/07 (with a response rate of 68% for adults), the overall response rate is, in fact, lower. The combined adult and child response rate adjusted for the NZHS was 49% for the interview and 41% for the examination. Nonetheless, the valuable advantages of a follow-up survey include the ability to combine for each participant the previously collected health data and data collected in the oral health survey, which is useful to examine longitudinal associations. A follow-up survey is also more time- and cost-effective. A lower response rate is considered to be typical of contemporary response rates for similar epidemiological surveys internationally (Ministry of Health 2010b).

Another advantage of it being a follow-up survey was the ability to thoroughly investigate potential non-response bias. The preceding NZHS contained questions about oral health and the use of oral health services, which enabled an examination of whether non-response was non-random in respect of the oral health variables. It was found that this was not the case (Ministry of Health 2010a).

5.6.2 Generalisability

The relatively low response rate is unlikely to affect the generalisability of these findings to the NZ dentate adult population because there was no evidence of non-response bias. Moreover, suitable statistical methods were applied to ensure that the estimates were generalisable to the New Zealand population.

It seems reasonable to assume that some of the dental trauma findings from the 2009 NZOHS can be applied to adult populations in other developed countries. This view is supported by similar findings from an American population-based study (Kaste et al. 1996). However, findings on risk markers, treatment and sociodemographic differences are likely to be unique to New Zealand. The compulsory social insurance scheme, the ACC, is unique to New Zealand and so these findings may be generalisable only to countries with similar all-inclusive State-funded insurance schemes.

5.6.3 Quality of the data collection

As to be expected of a large-scale survey such as the 2006 NZHS and the 2009 NZOHS, quality control over data collection was rigorous. The 2009 NZOHS methodology was based on common and gold-standard practice for similar epidemiological studies. The examinations were carried out using the Australian National Survey of Adult Oral Health 2004-06 examination protocols[10]. Comparing each examiner to the gold-standard examiner enabled assessment of inter-examiner reliability. A high level of consistency was achieved, and was comparable with international population-based oral health surveys[11]. The intra-class correlation coefficient (ICC) showed high levels of agreement (Ministry of Health 2010a). Although the reliability for most aspects of the dental examination

[10] Australian National Survey of Adult Oral Health 2004-06 (Ministry of Health 2010a)

[11] Australian National Survey of Adult Oral Health 2004-06; 1998 Adult Dental Health Survey in the United Kingdom (Ministry of Health 2010a)

was measured for 19 of the 21 examiners[12], consistency in the dental trauma examinations using the 2009 NZOHS classification was not tested.

As discussed above, the potential for recall bias with the self-reported data was a weakness of this study. However, it could be argued that dental injuries are traumatic in nature and are more likely to be recalled (Locker 2005). The findings of this study could support this assertion, since the self-reported prevalence of dental trauma (28%) of any teeth is not dissimilar to the clinical prevalence of dental trauma to the maxillary anterior teeth (23%). The NZOHS used a face-to-face -interview as well as a clinical examination. There have been no studies to date that have examined the agreement between a self-report method and clinical examination of dental trauma. Findings from the 2009 NZOHS show that the self-reported and clinical prevalence of dental trauma is similar in adults. A similar finding was discovered in a study of dental trauma school-children in Ontario, Canada, that utilized both a clinical examination and an interview. However, in both the study by Locker (2007) and the NZOHS, more severe categories of trauma such as missing teeth required verification from the participant as well as clinical signs. In addition to this, self-reported trauma could have occurred in the primary dentition, rather than the permanent dentition.

5.7 Findings

5.7.1 Prevalence and incidence

The overall self-reported prevalence of orofacial trauma was 41%. This is in contrast to Locker's study, which found that almost 16% of Canadian adults reported a history of injury to the mouth or teeth (Locker 2007).

Some 32,110 adults and children visited a dentist to register new orofacial injuries with ACC in the 12 months from 1st January 2008 to 31st December 2008. This figure does not include orofacial injuries recorded by another type of

[12] One examiner who only carried out three examinations was excluded; one set of replication records were lost

health professional, such as a doctor. The number of new injuries for 2008 appears to be slightly higher than previous years. Over a ten-year period covered by the financial years 1999 to 2008, Welch et al. (2010) found the number of new orofacial claims for adults and children to be (on average) 27,499 per financial year. However, they found that it had increased steadily over the second five years of that decade, with 31,257 claims recorded in the final year (Welch et al. 2010). This most likely reflects the increasing population of NZ. However, it could also highlight an increase in the rate of injuries, or alternatively, an increase in people seeking treatment. More research would be required to explore this.

The incidence of dental trauma is not able to be determined, because the ACC data included only people who have presented to a dentist, and therefore they do not represent the population at risk. A rate of people seeking treatment for their orofacial injury can indeed be determined, however. The rate of new orofacial injuries registered with ACC by a dentist was 32,110 per approximately 4.1 million people[13] for the year 2008. However, this assumes that all new injuries presenting to a dentist were registered with ACC, which may not be the case. In addition, it is also assumed that the entire estimated population of NZ at that time were all dentate and at risk of dental trauma.

Some 69% of participants with orofacial trauma reported that this had included damage to their teeth. In other words, the self-reported prevalence of dental trauma in adults was 28%. The proportion of orofacial injuries involving teeth was smaller than in Locker's (2007) study (85%); however, the overall prevalence of dental trauma was higher. Analysis of the 2009 NZOHS dataset revealed that 23% of adults had clinical signs of dental trauma to the maxillary six anterior teeth. Both the self-reported and the clinical prevalence estimates for dental trauma in this study are very similar to the 28% prevalence in adults reported for the USA (Kaste et al. 1996). The study by Kaste et al. (1996) examined the eight maxillary and mandibular incisors, and did not include people

[13] 2006 Census. NZ Government. [accessed 2017 August 8]; http://www.stats.govt.nz/Census/2006CensusHomePage/QuickStats/quickstats-about-a-subject/national-highlights.aspx

over the age of 50. Excluding people older than 50 years may account for the higher prevalence, since in the current study, clinical prevalence was not found to be higher in older adults. In addition to this, excluding older people would provide less chance for recall bias to influence the overall prevalence. Furthermore, the study by Kaste et al. (1996) examined eight teeth instead of the six in the NZOHS. That the findings from the current study suggest that mandibular incisors may sustain more trauma than maxillary canines means that future oral health surveys should include the lower incisors in the examination.

Findings from the 2009 NZOHS showed that 16% of children aged 7-17 years had one or more traumatised maxillary anterior permanent teeth. The difference in prevalence to the adult findings is to be expected. The permanent dentition erupts during the period between six and twelve years old (on average), so the permanent teeth have not been present in the mouth for very long and have had less chance of sustaining an injury. Younger children in this age group would also not have had all six of the permanent maxillary anterior teeth present at the time of the survey. This is reflected in the prevalence of 6% for children aged 7-11 years. However, older children aged 12-17 years had an estimated prevalence of 23%. This is the same prevalence as for adults, and could support previous evidence that most dental trauma occurs in childhood and adolescence. However, this is evidence of at least one traumatised tooth among the six maxillary anterior teeth; it does not indicate multiple traumatic episodes and damaged teeth. Thus, it cannot be concluded from these findings that the majority of dental trauma occurs before adulthood. The prevalence estimate also does not give an indication of the severity of the damage. Without similar population-based studies in New Zealand or Australia it is difficult to make comparisons.

5.7.1.1 Age

Interestingly, clinical dental trauma was not more prevalent in the older age groups. The cumulative nature of dental trauma means that a consistent gradient by age group would be expected, with a lower prevalence found in the younger age groups. Clinical dental trauma was significantly more common in the 35-44 age group, as was self-reported orofacial trauma. Neither clinical dental trauma

nor self-reported orofacial trauma showed a consistent gradient with age. However, significantly more people in the oldest age group reported previous dental trauma (in the interview) than those in the youngest age group. Although not statistically significant, there was generally a gradient with age, with a higher prevalence of self-reported dental trauma with older age. The disparity between the self-reported and clinical findings may highlight the problems incurred with a clinical survey of dental trauma, as discussed above.

There are several possible explanations for the inconsistent gradient by age. The self-reported data could be affected by recall bias, which is more likely to affect the older age groups, because trauma is likely to have occurred at a younger age. As discussed above, recall bias may have also affected dental trauma scoring for the clinical examination for older people. In addition, older people's teeth originally treated for trauma may have undergone more dental procedures or extractions for other reasons (such as caries), thus masking the clinical signs of dental trauma. In addition to recall bias, this could result in under-reporting for older age groups.

In the younger age groups, the significantly higher prevalence of self-reported orofacial trauma and clinical dental trauma in the 35-44-year-olds could be attributed to several factors. Participants who were aged 35-44 in 2009 were young children or adolescents when the ACC was introduced in 1974. Although this is not likely to have influenced the incidence of orofacial trauma, it may have brought about an awareness reflected in the self-reported data (and a higher prevalence of "treated trauma" in the clinical data) which could be straightforward to identify. There was a consistent gradient with age in the three youngest age groups. It is possible that, in addition to widely reported (Glendor et al. 1996; Eilert-Petersson et al. 1997) peaks in orofacial trauma incidence in childhood and adolescence, there is another peak in adults between 18 and 44 years old. This is supported by the study by Love and Ponnambalam (2008) in Dunedin (NZ), which found that the highest number of people seeking treatment at the University Dental School for orofacial trauma were between 16 and 25 years old. People aged 35-44 years in 2009 may have sustained more dental trauma in childhood than other age groups. This could have occurred because

sports or games that were popular at the time carried a higher risk of dental injury, or there may have been fewer preventive measures, such as mouthguards.

5.7.1.2 Sex

More males than females reported orofacial trauma, with a ratio of 1.6:1. Likewise, more males than females had clinical signs of dental trauma, with a ratio of 1.4:1. This finding is consistent with those from most studies of dental trauma, of both children and adults, and very close to the sex difference found among American adults in the study by Kaste et al. (1996). Interestingly, self-reported damage to teeth did not differ with sex. More males than females registered dental injuries with the ACC during 2008. However, as discussed earlier, this does not necessarily reflect the sex distribution of dental injuries. Nonetheless, it does support the findings from the NZOHS.

A higher prevalence of trauma among males appears to be consistent in all age groups in the NZOHS. However, more research is required for older people, since it is likely that a peak in dental trauma among older females will become more apparent. The cumulative nature of dental trauma means that such a sex difference might not be apparent in older age groups. In general, life expectancy is increasing, with females generally living longer than males, and more older people keeping their own teeth. In a study of people 65 years and older, Thomson et al. (2003) found that older women had a higher rate of facial fractures, and these could conceivable include concomitant dental trauma. This hypothesised pattern is reflected in the ACC findings, which show a considerable sex difference among the younger age groups in registering orofacial trauma with ACC. However, this difference becomes less apparent with increasing age, and more females than males registered orofacial trauma in the 65+ years age group.

5.7.1.3 Ethnicity

More Māori and European/other participants in the 2009 NZOHS reported orofacial trauma, but there was no ethnic difference in self-reported or clinical dental trauma. This is similar to the study by Kaste et al. (1996), which showed similar prevalence in different ethnic groups, including minority groups. A

higher prevalence of orofacial injury in Māori is consistent with previous NZ studies on maxillo-facial fractures (Koorey et al. 1991; Buchanan et al. 2005; Adsett et al. 2013). An ethnic difference is also found in other parts of oral health. The 2009 NZOHS technical report revealed that Māori and Pacific people generally have poorer oral health than NZ European and other ethnic groups (Ministry of Health 2010b).

5.7.1.4 Deprivation and education

There were no significant differences by deprivation or education level for clinical trauma or self-reported trauma. This finding was expected, and it is consistent with most studies. There is limited literature on the association between deprivation and dental trauma, and most studies have included convenience samples of children (Marcenes and Murray 2001; Frujeri et al. 2014; Lexomboon et al. 2016). Considering that most dental trauma occurs in younger years at school, and schooling is compulsory in NZ until the age of 16, a difference by deprivation would not be expected. The main causes of dental trauma (such as falls, cars) do not appear to be differentially related to socioeconomic status in developed countries. Locker observed a higher prevalence of dental trauma reported by people at both ends of the education spectrum (Locker 2007). A possible explanation for this may be differing causes of trauma in different socioeconomic groups. However, this difference has not been replicated in other studies.

Multivariate analysis of the NZOHS data showed that sex and age were associated with both self-reported orofacial trauma and clinical dental trauma. Being male and aged 35-54 years was associated with greater odds of orofacial trauma. Age was the sole factor associated with self-reported dental trauma, while orofacial trauma was also associated with ethnicity and people aged 35-44 and 45-54. Self-reported dental trauma was the only outcome that showed a gradient with age, with the odds of having dental trauma at over 75 years twice those for the 35-44 age groups. The cumulative nature of dental trauma means that this is to be expected. However, it was hypothesised that sex would be also be associated with

self-reported dental trauma. The higher rate in the 35-44 age group suggests that this cohort will require more treatment in the future; alternatively, it may be an indication of changes in rate. Further research is needed to examine this. People aged 18-24 years were over-represented in the number of new dental injury ACC claims for the month of June 2008. This was followed by people aged 35-44. This could suggest an increase in the rate of trauma in young adults, although more research is required to determine this.

5.7.2 Teeth involved in dental trauma

That teeth 11 and 21 were the most common traumatised teeth of the six included in the NZOHS examination is consistent with findings from other clinical studies. The maxillary lateral incisors were the next most often affected. This is supported by findings from the ACC data which show that the maxillary central incisors were the most frequently injured teeth, followed by the maxillary lateral incisors. However, the next most frequently injured teeth—according to the ACC data—were the mandibular central and lateral incisors, rather than the maxillary canines. Participants were not asked in the NZOHS questionnaire which teeth had been damaged.

The NZOHS findings showed more traumatised teeth on the right side than the left, but the ACC data did not reveal a left or right-sided predilection. Some previous studies have found that dental trauma appeared to affect one side rather than the other, but this has not been a common finding.

Most participants had damage involving only one of the six teeth examined, with 64% having one injured tooth, and 28% having two injured teeth. The limitations of a survey means that it cannot be determined whether multiple teeth were involved in the same traumatic incident or the same tooth was traumatised on multiple occasions. This is similar to the US and Canadian findings.

5.7.3 Type of dental trauma

Most self-reported dental trauma in the 2009 NZOHS involved a "chipped or broken" tooth. This finding was consistent with most studies of dental trauma.

The majority of clinical trauma observations from the examination involved treated trauma. This was a broad category that encompassed a repair of any size and involvement. However, it is reasonable to assume that most would have involved a repair of a fractured tooth. Those findings are supported by the ACC data, which revealed that over 90% of the June 2008 injuries were *Minor* and *Fracture or loosening* injuries. These included concussion, enamel infraction, enamel fracture, enamel-dentine fracture, subluxation and root fracture.

There was a surprisingly high occurrence of self-reported "knocked out" teeth (10%). However, this was lower than self-reported avulsion and luxation in Locker's (2007) study, which were 25% and 7%, respectively. It is similar, however, to the proportion of traumatised teeth (in people aged 6-50 years old) that were "missing due to trauma" in the study by Kaste et al. (1996) (10%). The difference in rates between the study by Locker (2007) and the 2009 NZOHS findings could be explained by participants recalling avulsed primary teeth in the latter. It is worth noting that the category "knocked out" does not differentiate between "avulsed and replanted" or "avulsed and lost", each of which would have different implications for treatment and survival. Prognosis would also be influenced by the age of the participant and the stage of root development.

By contrast, only just over 2% of clinical dental trauma in this current study involved an avulsed tooth. The NZOHS clinical classification also does not stipulate whether an observation of avulsion included teeth avulsed and replanted, as verified by the participant.

5.7.4 Timing

Most self-reported orofacial trauma in adults had occurred more than five years prior to the survey. This is consistent with other studies showing that the highest incidence of dental trauma is during childhood and adolescence (Eilert-Petersson et al. 1997). However, there may be additional peaks of dental trauma in adulthood, as discussed above. The demographic characteristics of people experiencing dental trauma may change in the future, and more research on the adult population needs to be done.

5.7.5 Treatment of dental trauma

Some 73% of participants with self-reported dental trauma remembered seeking or receiving care for their injury. This is similar to the 79% in the study by Locker (2007) who reported seeking treatment from a health professional. By contrast, almost 10% of the NZOHS participants had a clinical observation of "treated trauma". In other words, 41% of people with clinical signs of dental trauma had treated trauma. This difference is explained by the difference between a questionnaire survey and a clinical examination survey, and the differences between the classification definitions used. For instance, "treatment" encompasses anything between a consultation and an extraction. Neither of these "treatments" would have been captured by the clinical examination, but would have been included in responses to the questionnaire.

There were ethnic differences in the proportion who sought treatment. A higher proportion of European/other participants had sought treatment than the other ethnic groups. There were no statistically significant differences by sex, age, education or deprivation. Since ACC support is available to all NZ citizens for at least an assessment of dental trauma, this finding could indicate differences in understanding the services available, access to a dentist or in oral health values, or even the perception of institutional racism. This could be due to language barriers and deeper-set health inequalities between ethnic groups. Locker (2007) found an association between education and treatment, with more-educated people more likely to have sought treatment.

The main reason given for not seeking care for a dental injury was that the participant didn't think it was serious enough. This could indicate a large proportion of minor dental injuries, such a small enamel fracture. Alternatively, it could indicate a large proportion of people incorrectly perceiving their injury as minor, resulting in later pain and higher treatment needs which could have been prevented with early treatment. This finding indicates that there may be a need for better education on the importance of early assessment and treatment of all dental injuries. The second most common reason for not seeking treatment was cost. This could indicate an under-utilisation of people's ACC contributions or,

despite the contribution, the remaining cost of the treatment becoming a barrier to care for some of the population.

There were ethnic differences in self-reported treatment. Within the Māori group, more people did not seek treatment because it was not thought to be serious enough. Although not statistically significant, more people in the Māori and Pacific groups found cost a barrier than those who were Asian or European/other. Some 1% of participants reported that dental anxiety had prevented them from seeking treatment, and although not statistically significant, a higher proportion of Māori (8%) reported this to be the case. Fewer Māori than other ethnic groups felt that their teeth appeared similar after repair, and a greater proportion reported that they appeared worse. Almost one-third of Māori reported that function was worse after repair. It is not clear what could cause this ethnic difference. It may be a cultural difference in perception of dental treatment, or a reflection of the general poor oral health in this ethnic group.

5.7.6 ACC uptake

Only just over half of the NZOHS participants were aware that the ACC could help with payment for dental injuries. Moreover, only 40% of participants with dental trauma reported that the ACC had contributed towards the cost of treatment for their last injury. The proportion reporting an ACC contribution seems to be very low considering that most, if not all[14], participants would have been eligible for an ACC contribution for at least the initial assessment and examination because they would have sustained their dental injury in NZ. All NZ dentists are ACC providers; thus, this should not be a barrier to ACC registration of a dental injury. This surprisingly low finding could be explained by a number of factors. The injury may not in fact have been due to dental trauma, being instead a result of bruxism, or fracture due to caries, for instance. Some dental treatment for dental trauma is not completely covered by the ACC contribution, especially if that contribution has been reduced due to the presence of concomitant disease such as caries or

[14] There may be a very small proportion of the survey sample who were not living in NZ at the time of injury, and therefore were not eligible for ACC contribution.

periodontal disease. In such cases, the patient will need to pay the outstanding cost to the dentist. In situations such as these, the patient may not have realised or had forgotten that there was an ACC contribution for the treatment of their dental injury. However, these explanations do not account for the low proportion of knowledge of ACC cover for dental injuries.

There was no sex difference in knowledge of the ACC contribution, but significantly fewer Asian and Pacific people (than other ethnic groups) were aware of this, in contrast to those in the European/other group. This may indicate a lack of awareness in some ethnic groups, and possibly factors such as a language barrier having an effect. In addition, there was an age difference, with significantly fewer people in the youngest and oldest age groups aware of ACC cover for dental trauma. There was also a consistent gradient by deprivation; that is, fewer people in more deprived areas were aware of ACC cover for dental trauma. Similarly, higher education level was associated with a greater awareness of ACC cover, although this too was not statistically significant. These findings indicate that there could be inequity in care through information about ACC cover not being readily available to poorer people, ethnic minorities and less educated people. Awareness raising in respect of ACC cover for dental treatment could be combined with dental trauma prevention information and conducted more effectively for these groups. Appropriate vehicles could include television or easy-to-read pamphlets/posters in different languages at the doctors and in government offices, such as Work and Income New Zealand (WINZ).

These findings suggest that dental trauma data from the ACC may provide a gross underestimation of dental trauma in NZ. In addition to poor ACC knowledge and uptake, just over one-quarter of people with dental trauma reported that they did not seek treatment. This is the first study in New Zealand to investigate the uptake of ACC support for dental injuries at a population level, and further research is warranted.

An average of 80% of teeth injured in June 2008 received treatment in the following five years. For injuries registered with the ACC in June, the mean number of treatments ranged from one to 18. Analysis of the ACC data showed

that more severe injuries required more treatment. The most common injuries (*Minor injuries*—concussion, enamel infraction or enamel fracture), required the least amount of treatment. Moreover, more treatment was required for maxillary teeth than mandibular teeth, for similar injuries. This might be due to aesthetic concerns, or different treatments recommended for anterior teeth. It could also be due to type 2 error, since the proportion of injured posterior teeth was very small.

5.7.7 Outcomes of dental trauma

Outcomes and causality cannot be determined from a cross-sectional survey. Treatment data from the ACC provide insight into the severity of the injury, the possible complications that have occurred, and their burden to both the individual and society.

Generally, for both the maxilla and mandible, more treatment was needed for more severe injuries. A considerable amount of treatment was required for one month's worth of dental injuries over a five-year period. The nature of dental trauma means that this treatment can be on-going for life. For the same injury type, anterior teeth required more treatment than posterior teeth.

Overall, more root canal treatments were undertaken than the other two treatment modalities, which was anticipated. However, for the maxillary lateral incisors, the difference in counts between extractions and root canal treatments was small, and in fact more extractions than root canal treatments were provided for tooth 22. This is most likely explained by the small number of those teeth which had been injured. Another explanation could be that the maxillary lateral incisors suffered more from the injuries; in other words, they were less resilient, possibly because they are smaller and narrower than the central incisors. Furthermore, these teeth may have had previous dental trauma, and were already very compromised.

Of the three treatments analysed in this study, root canal treatment was more common than extractions or implants for *Severe fracture* injuries (complicated crown fracture or crown-root fracture) and *Displacement* injuries (extrusive or

lateral luxation) in the maxilla, while more common for *Fracture or loosening* (enamel-dentine fracture, subluxation or root fracture) and *Severe displacement* (avulsion or intrusive luxation) injuries in the mandible. This difference between the upper and lower teeth is most likely due to the small number of teeth that sustained *Severe fracture*, *Displacement* and *Severe displacement* injuries in the mandible. *Severe fracture* and *Displacement* injuries would have presented as a dental emergency; such injuries have a higher rate of pulp necrosis than *Minor injuries* and *Fracture or loosening injuries*. Teeth with *Severe displacement* injuries would also have a high rate of pulp necrosis but could have suffered severe complications due to periodontal ligament injury, which could result in an extraction. However, in such cases, an extraction may not be needed for many years.

In the maxilla, more extractions were provided for *Displacement* and *Severe displacement* injuries than the other injury groups. *Displacement* and *Severe displacement* represent more severe injuries with a higher rate of serious complications and possible tooth loss, and so this finding was anticipated. In addition, more implants were placed for *Displacement* and *Severe displacement* injuries. However, more extractions were carried out in the lower teeth for *Severe fracture* and *Displacement* than other injury types. Once more, this could be due to error from the relatively low number.

An interesting finding was the proportion of root canal treatments carried out in maxillary teeth for *Minor injuries*. *Minor* injuries (concussion, enamel infraction or enamel fracture) would be expected to have a very low chance of pulp necrosis. There are several possible reasons for this observation. The teeth may have been incorrectly diagnosed and had a more serious injury, such as a lateral luxation. Alternatively, the tooth may have had a previous and more serious injury; although this may have been registered with the ACC at the time, it is possible that the treatment would be linked with the most recent trauma. The teeth may have been compromised by caries or periodontal disease. Finally, teeth with *Minor injuries* may have had a concomitant severe injury that was also recorded.

Another surprising finding was the number of extractions and root canal treatments provided for *Displacement* injuries (extrusive or lateral luxation) in the maxilla. Extractions featured more frequently than root canal treatments or implants in the premolars. However, roughly equal number of extractions and root canal treatments were carried for the maxillary incisors. A likely explanation for this could be the pre-accident condition of these teeth, as discussed above.

There was a difference between the maxilla and mandible in the most common treatment for *Severe displacement* injuries (avulsion or intrusive luxation). Extractions were more common than root canal treatment or implants in the maxilla, and root canal treatment was more common for the mandibular teeth. This is noteworthy, because it shows a possible difference in treatment between the upper and lower teeth. However, the numbers are relatively small, as discussed above, and more research is warranted. The largest proportion of implants were done for *Displacement* and *Severe displacement* injuries, and these were mainly replacing maxillary incisor teeth.

5.7.8 Preventive measures

The 2009 NZOHS included interview questions on contact sport and mouthguards. Mouthguards protect teeth from fracture and redistribute the force of the impact, thus reducing the severity of injury to the teeth, soft tissues and alveolar bone. In NZ, the Dental Association recommends the use of mouthguards for contact sports, however there is no nation-wide policy. Contact sport is defined as "a sport in which the impact of one person against another is an inherent part of the sport" (Kent 2006). An online search revealed that in NZ, mouthguard policies are set by governing sports bodies such as the NZ Rugby Union, team managers and junior sports associations. There is a wide variation between different sports and player level (professional, senior or junior). For instance, it is mandatory to wear a mouthguard for matches in all levels of rugby union in NZ, but it is only a recommendation for rugby league players. A study of ACC registered sports-related dental injuries in NZ by Love et al. (1998) revealed that from 1993-1996, the main sports contributing to dental injuries—excluding rugby union—were swimming, rugby league, basketball, cricket, hockey and

soccer. The most common age to have a sports-related dental injury was between 10 and 19. A study by Welch et al. (2010) found that over a 10-year period, sports injuries accounted for approximately one-quarter of new orofacial injuries in NZ, and the majority were due to rugby, which included rugby union, rugby league and touch rugby. However, although contributing to the majority of rugby-related injuries, rugby union-associated orofacial injuries registered with the ACC were shown to decrease since mouthguards were made compulsory during matches (Quarrie et al. 2005; Welch et al. 2010). In contrast, touch rugby-related dental injuries increased (Love et al. 1998; Welch et al. 2010). Unfortunately, little is known about mouthguard use during informal rugby games and practices, as well as in other contact sports. Studies suggest that mouthguard use may be beneficial in other sports not usually thought of as "contact sports". Findings from the 2009 NZOHS suggest that adherence to recommendations on mouthguard use is low, and further research is warranted in this area. Similar findings were discovered in a study in Israel, which found that mouthguard knowledge was low among young adults participating in sports, and less than 3% of those playing sport used a mouthguard.

5.8 Recommendations

Further research examining dental trauma in adults is recommended. This study has shown that dental trauma is a significant health burden. At-risk groups have been identified, and it is recommended that prevention and acute management information is made more readily available to adults, and especially those at risk. Information on ACC help with dental injuries should also be reviewed to ensure that a lack of knowledge is not preventing some of the population seeking treatment.

Dental trauma questions and examination could be included in the next National Oral Health Survey. In future surveys, the examination could include the maxillary and mandibular incisors; that is, eight teeth. The overjet and lip competence could be measured and a record of whether orthodontic treatment has been done. The use of a modified classification specifically designed for epidemiological studies

for the clinical examination will reduce ambiguity in the method. More research should investigate ACC data and outcomes.

5.9 Conclusion

The findings of this study highlight the complex nature of dental trauma and the difficulties in researching this health problem. Dental trauma in the NZ adult population constitutes an important public health issue, given that many will need life-long follow-up and treatment. More emphasis on dental trauma prevention is warranted, especially among males. At-risk groups with a high treatment burden (such as males and those aged 35-44 years old in 2009) will require an ever-increasing amount of treatment. Public awareness of ACC cover for dental injuries may need to be bolstered to enable equal access for injury care. Overall, a greater emphasis on prevention and the importance of initial care of dental injuries could reduce the burden on the individual and NZ society.

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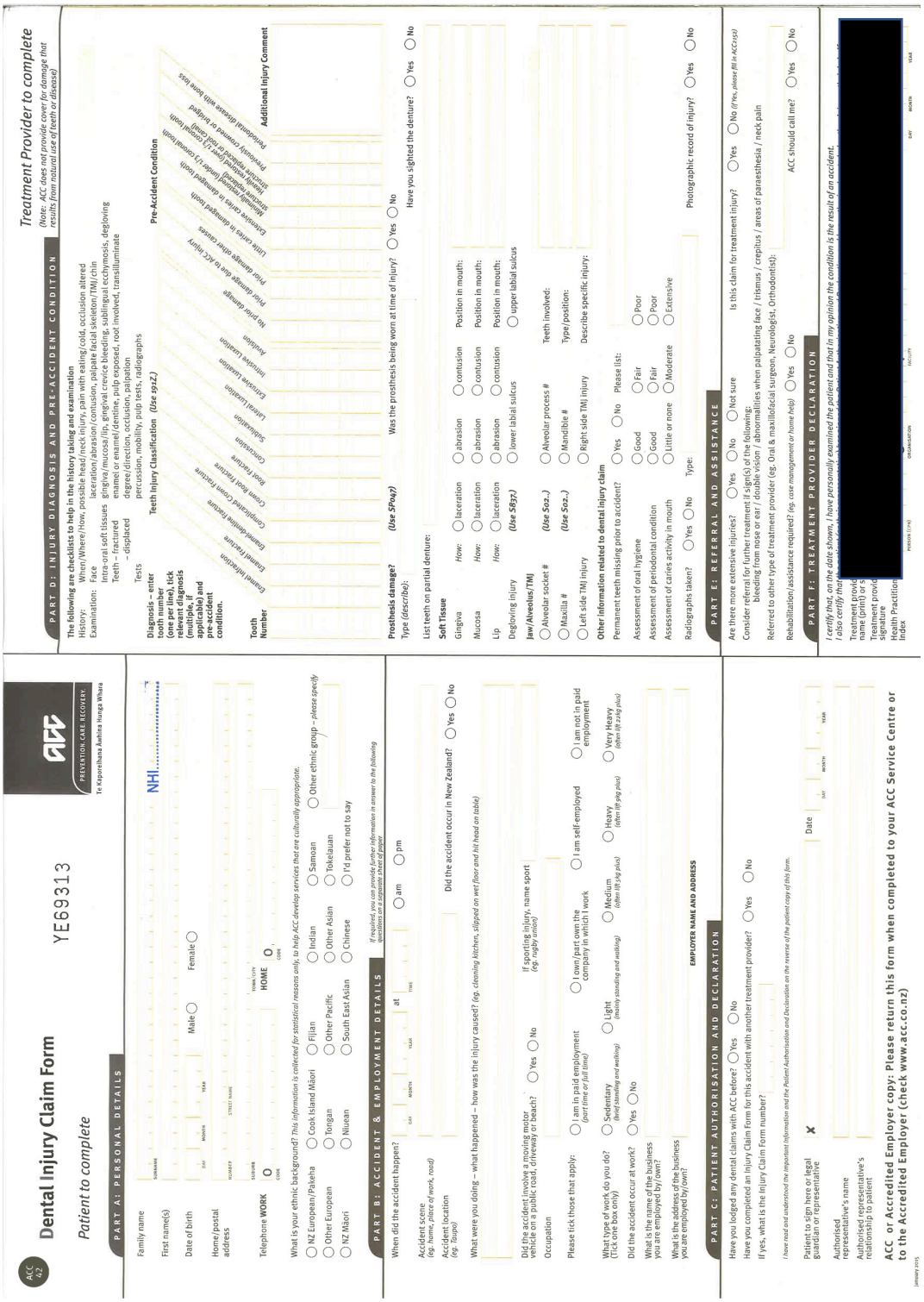
Appendices

Appendix I. Dental injury claim form



Dental Injury Claim Form

Patient to complete

YE69313

PART A1: PERSONAL DETAILS

PART B1: ACCIDENT & EMPLOYMENT DETAILS

PART C: PATIENT AUTHORISATION AND DECLARATION

Treatment Provider to complete

(Note: ACC does not provide cover for damage that results from natural use of teeth or disease)

PART D: INJURY DIAGNOSIS AND PRE-ACCIDENT CONDITION

PART E: REFERRAL AND ASSISTANCE

PART F: TREATMENT PROVIDER DECLARATION

ACC or Accredited Employer copy: Please return this form when completed to your ACC Service Centre or to the Accredited Employer (check www.acc.co.nz)

Appendix II. Dental trauma classification examples

Table 60. Andreasen classification (Andreasen et al. 2007)

Classification
Crown infraction. Incomplete fracture of the enamel
Uncomplicated crown fracture. A fracture confined to the enamel or dentine but not exposing the pulp
Complicated crown fracture. A fracture involving enamel and dentine, and exposing the pulp
Root fracture. A fracture involving the dentine, cementum and the pulp
Uncomplicated crown-root fracture. A fracture involving enamel, dentine, cementum, not exposing the pulp
Complicated crown-root fracture. A fracture involving enamel, dentine and cementum, and exposing the pulp
Concussion. Injury without abnormal loosening or displacement but with market reaction to percussion
Subluxation (loosening). Injury with abnormal loosening but without displacement of tooth
Intrusive luxation (central dislocation)
Extrusive luxation (peripheral dislocation, partial avulsion)
Lateral luxation
Exarticulation (complete luxation)

Table 61. Glendor classification (Glendor et al. 1996)

Classification	
Uncomplicated	Fractures without pulp exposure (infraction, uncomplicated crown fracture, uncomplicated crown-root fracture)
	Luxation without dislocation (concussion, subluxation)
Complicated	Fractures with pulp exposure (complicated crown fracture, complicated crown-root fracture, root fracture)
	Luxation with dislocation (intrusion, extrusion, lateral luxation, exarticulation

Table 62. Classification of Traumatised Anterior Teeth (Ellis 1960; Ellis and Davey 1970)

Classification	
Class 1	Simple fracture of the crown – involving little or no dentine
2	Extensive fracture of the crown – involving considerable dentine, but not the dental pulp
3	Extensive fracture of the crown – involving considerable dentine and exposing the dental pulp
4	The traumatised tooth which becomes nonvital – with or without loss of crown structure
5	Teeth lost as a result of trauma
6	Fracture of the root – with or without loss of crown structure
7	Displacement of a tooth – without fracture of crown or root
8	Fracture of the crown en masse and its replacement
9	Traumatic injuries to deciduous teeth

Table 63. NHANES III classification (NIDR) (Kaste et al. 1996)

Classification
No evidence of traumatic injury
Unrestored enamel fracture is present that does not involve dentine
Unrestored fracture that involves dentine
Untreated damage as evidence by one of the following: (a) dark discolouration as compared with the other teeth – a discolouration of one tooth or adjacent teeth, which are otherwise healthy, is considered a sign of injury, or (b) presence of a swelling and/or fistula in the labial or lingual vestibule adjacent to an otherwise healthy tooth
Fracture restored, either with a full crown or a less extensive restoration. It may be necessary to question the subject to determine the reason for the restorations
Presence of a lingual restoration as a sign of endodontic therapy, and a positive history from the subject of root canal treatment following traumatic injury
Tooth missing due to trauma
Any tooth or space that does not fall within the preceding categories

Appendix III. University of Otago ethics approval

D17/042

Academic Services
Manager, Academic Committees, Mr Gary Witte

3 March 2017

Professor W M Thomson
Faculty of Dentistry
Division of Health Sciences

Dear Professor Thomson,

I am writing to confirm for you the status of your proposal entitled "**Dental trauma in New Zealand adults: occurrences, risk factors and impact in the 2009 National Oral Health Survey**", which was originally received on February 17, 2017. The Human Ethics Committee's reference number for this proposal is **D17/042**.

The above application was Category B and had therefore been considered within the Department or School. The outcome was subsequently reviewed by the University of Otago Human Ethics Committee. The outcome of that consideration was that the proposal was approved.

Approval is for up to three years from the date of HOD approval. If this project has not been completed within three years of this date, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

Appendix IV. Interview questions related to dental trauma

(Ministry of Health. [accessed 2015 March 5]; http://www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/surveys/current-recent-surveys/oral-health-survey)

Module 32: Orofacial trauma
OHSA_Q102. Have you ever had an injury to your mouth, teeth, jaw or lips (an injury might be a knock, hit or any accident, even if it didn't do any visible damage)?
1 Yes
2 No [Go to OHSA_Q114]
98 Don't know [Go to OHSA_Q114]
99 Refused [Go to OHSA_Q114]

OHSA_Q103. How long ago did this injury happen?
Showcard Q103: Module 32
1 Within the last 12 months
2 More than one year but less than 2 years
3 More than 2 years but less than 3 years
4 More than 3 years but less than 5 years
5 More than 5 years
98 Don't know
99 Refused

OHSA_Q104. Did this injury or accident cause any damage to your teeth? (This could be a tooth being knocked but not loosened, through to a tooth being broken or knocked out)
1 Yes
2 No [Go to OHSA_Q114]
98 Don't know [Go to OHSA_Q114]
99 Refused [Go to OHSA_Q114]

OHSA_Q105. What damage did the accident cause to your teeth?
Showcard Q105: Module 32
The tooth/teeth were:
1 Knocked but not displaced (not moved out of their normal position)
2 Knocked and displaced (moved out of their normal position)
3 Knocked and superficially cracked on the surface
4 Knocked out
5 Chipped/ broken
98 Don't know
99 Refused

OHSA_Q106. Did you seek / receive care for this dental injury?
1 Yes [Go to OHSA_Q108]
2 No
98 Don't know
99 Refused

OHSA_Q107. If no to seek/receive care: If you did not seek/receive treatment for your dental injury what was the reason?

Showcard Q107: Module 32
1 Didn't know how to
2 Couldn't get an appointment
3 Didn't want to make a fuss
4 Couldn't be bothered
5 Had no transport to get there
6 Cost too much
7 Didn't think it was serious enough
8 Lack of childcare
9 Couldn't get an appointment soon enough / at a suitable time
10 It was after hours
11 Couldn't get in touch with the dental professional
12 Couldn't spare the time
13 Anxiety or fear of dental treatment
14 ACC paperwork too complicated
15 Other, please specify
98 Don't know
99 Refused

[After answering OHSA_Q107, if answered No, Don't know, or Refused to OHSA_Q106, go to OHSA_Q114]

OHSA_Q108. If yes to received care: Did the dental professional discuss with you, as much as you wanted, the treatment options for repairing / replacing your injured teeth?
1 Always
2 Often
3 Sometimes
4 Occasionally
5 Never
98 Don't know
99 Refused

OHSA_Q109. If yes to received care: If your teeth were repaired / replaced following this injury, how did your teeth function after the repair was complete?
1 Better than before the accident
2 About the same as before the accident
3 Worse than before the accident
98 Don't know
99 Refused

OHSA_Q110. If yes to received care: If your teeth were repaired / replaced following this injury, how did your teeth look after the repair was complete?
1 Better than before the accident
2 About the same as before the accident
3 Worse than before the accident
98 Don't know
99 Refused

OHSA_Q111. If yes to received care: If your teeth were repaired / replaced following this injury, are the repaired/replaced teeth still in good order?

1 Yes
2 No
98 Don't know
99 Refused

OHSA_Q112. If yes to received care: Have you seen a dental professional to have these repaired / replaced teeth checked since the repairs were first done?
1 Yes
2 No
98 Don't know
99 Refused

OHSA_Q113. Did ACC help pay for the treatment of your last dental injury?
1 Yes
2 No
98 Don't know
99 Refused

Module 10: ACC – knowledge of cover for dental trauma [all adults]

OHSA_Q52. Do you know whether ACC can help pay for treatment when you have an injury to your mouth and teeth?
Showcard Q52: Module 10
1 Yes, they can help
2 No, they can't or won't
3 Not sure if ACC can help
98 Don't know
99 Refused

Module 14: Wearing of mouthguards [adults with natural teeth]
OHSA_Q62. Do you play contact sport?
1 Yes
2 No [Go to OHSA_Q65]
98 Don't know [Go to OHSA_Q65]
99 Refused [Go to OHSA_Q65]

OHSA_Q63. When you are playing contact sports do you wear a mouth guard to protect your teeth from injury?
Showcard Q63: Module 14
1 Always
2 Often
3 Sometimes
4 Occasionally
5 Never [Go to OHSA_Q65]
98 Don't know [Go to OHSA_Q65]
99 Refused [Go to OHSA_Q65]

Appendix V. Stata programming files (2009 NZOHS)

Programming files are recorded on compact disc attached to the back cover of this thesis.

Appendix VI. ACC ethical approval

3 February 2017

Nina Scott
Department of Oral Rehabilitation
University of Otago

Sconi120@student.otago.ac.nz

Dear Nina

ACC Ethics Committee application #326 Dental injury data to complement clinical doctorate research on dental trauma

Thank you for your research proposal which was considered by the ACC Research Ethics Committee at its meeting on 1 February 2017.

The Committee has **approved** your research proposal subject to the condition that you provide evidence of ethics approval you have received from any other ethics committee for your research, to us.

Please note that the approval applies only for use of ACC data for the purposes that have been requested in your proposal.

The committee would appreciate a copy of the final report once your research is completed.

Please advise the Committee straightaway if your research proposal changes in any significant way.

Your data request needs to go to Andrew Rae, Manager Customer Analytics datarequest@acc.co.nz. Please include your ethics approval letter in your request.

We wish you all the best with your research.

Yours sincerely

MREK (on behalf)

Melanie Martin
Secretary, ACC Ethics Committee

pp John Kleinsman
Co-Chair, ACC Ethics Committee

Appendix VII. SPSS programming files (ACC)

Programming files are recorded on compact disc attached to the back cover of this thesis.

Appendix VIII. Supplementary tables

Table 64. Sex by other sociodemographic characteristics for those who reported orofacial trauma included damage to teeth (data are row percentage unless otherwise indicated; brackets contain 95% CI)

	Sex	
	Female	Male
Age group		
18-24	53.9 (28.7, 77.2)	46.1 (22.8, 71.3)
25-34	42.7 (28.2, 58.7)	57.3 (41.3, 71.8)
35-44	41.4 (32.6, 50.7)	58.6 (49.3, 67.4)
45-54	37.6 (28.1, 48.2)	62.4 (51.8, 71.9)
55-64	40.7 (29.1, 53.4)	59.3 (46.6, 70.9)
65-74	40.8 (26.4, 56.9)	59.2 (43.1, 73.6)
75+	14.1 (6.6, 27.8)	85.9 (72.2, 93.4)
Ethnic group		
Māori	50.4 (43.7, 57.1)	49.6 (42.9, 56.3)[a]
Pacific	29.9 (14.9, 50.9)	70.1 (49.1, 85.1)
Asian	37.2 (17.2, 62.7)	62.8 (37.3, 82.8)
European/Other	40.3 (35.2, 45.6)	59.7 (54.4, 64.8)
Deprivation quintile		
1 (least deprived)	40.5 (30.2, 51.7)	59.5 (48.3, 69.8)
2	31.3 (22.3, 42.0)	68.7 (58.0, 77.7)
3	45.5 (30.8, 61.0)	54.5 (39.0, 69.2)
4	42.6 (29.4, 56.9)	57.4 (43.1, 70.6)
5 (most deprived)	44.2 (31.4, 57.8)	55.8 (42.2, 68.6)
Highest education level		
Primary	53.4 (37.5, 68.6)	46.6 (31.4, 62.5)
Secondary/vocational	39.4 (33.2, 45.9)	60.6 (54.1, 66.8)
University	37.3 (26.5, 49.5)	62.7 (50.5, 73.5)
All combined	40.1 (35.5, 44.9)	59.9 (55.1, 64.5)

[a]P<0.05

Of those that reported their orofacial trauma had included a dental injury (that is, approximately 28% of all adult participants), there were more males than females. This was consistent in all age groups except the 18-24 group. There were slightly more females than males in the Māori group and the primary education group, but these findings were not statistically significant.

Table 65. Age by other sociodemographic characteristics for those who reported orofacial trauma included damage to teeth (data are row percentage unless otherwise indicated; brackets contain 95% CI)

	Age group						
	18-24	25-34	35-44	45-54	55-64	65-74	75+
Sex							
Female	8.9 (5.2, 15.1)	15.7 (10.2, 23.3)	29.6 (23.5, 36.6)	22.1 (16.2, 29.5)	12.5 (8.5, 18.0)	9.4 (6.1, 14.3)	1.7 (0.8, 3.6)
Male	5.1 (2.1, 11.7)	14.1 (9.4, 20.6)	28.1 (21.6, 35.6)	24.6 (17.9, 32.7)	12.2 (8.8,16.9)	9.2 (5.9, 14.0)	6.7 (4.4, 10.1)
Ethnic group							
Maori	12.9 (7.8, 20.7)	24.5 (17.4, 33.3)	28.1 (22.1, 25.0)	17.7 (13.2, 23.3)	11.0 (7.4, 16.1)	4.6 (2.5, 8.5)	1.3 (0.5, 3.3)[a]
Pacific	9.1 (1.6, 38.5)	47.1 (25.4, 70.0)	22.0 (10.8, 39.5)	16.7 (6.7, 35.9)	1.9 (0.2, 14.0)	1.4 (0.1, 11.4)	1.9 (0.3, 10.5)[a]
Asian	31.1 (11.1, 62.0)	30.6 (13.4, 55.8)	11.0 (4.8, 23.0)	14.8 (5.6, 33.7)	6.8 (2.8, 15.9)	2.7 (0.7, 10.1)	3.0 (0.5, 15.8)[a]
European/Other	5.2 (2.8, 9.4)	12.7 (8.7, 18.1)	29.8 (24.7, 35.5)	24.2 (18.8, 30.6)	13.0 (9.6, 17.3)	10.2 (7.4, 13.8)	5.0 (3.3, 7.3)[a]
Deprivation quintile							
1 (least deprived)	4.3 (0.9, 17.7)	9.8 (3.8, 22.6)	29.8 (18.5, 44.2)	32.8 (20.9, 47.4)	12.4 (6.4, 22.8)	8.0 (3.2, 18.7)	2.9 (0.9, 9.3)
2	9.6 (3.2, 25.7)	7.7 (3.0, 18.0)	24.5 (14.6, 38.2)	27.1 (15.9, 42.1)	14.5 (8.0, 24.9)	12.5 (7.0, 21.5)	4.0 (1.6, 9.7)
3	4.9 (1.4, 15.8)	15.7 (7.3, 30.8)	26.7 (17.7, 38.1)	21.9 (12.6, 35.1)	11.9 (6.1, 22.1)	13.7 (8.1, 22.1)	5.1 (2.2, 11.7)
4	5.1 (1.2, 19.3)	20.1 (10.5, 35.0)	38.6 (26.4, 52.5)	8.9 (4.5, 16.9)	14.7 (7.7, 26.3)	4.9 (2.0, 11.2)	7.7 (3.5, 15.9)
5 (most deprived)	9.1 (3.1, 24.1)	24.5 (15.0, 37.2)	24.0 (14.4, 37.1)	24.4 (14.6, 37.7)	6.9 (3.2, 14.3)	6.9 (3.1, 14.7)	4.2 (1.5, 11.4)
Highest education level							
Primary	2.9 (0.4, 18.0)	6.1 (2.5, 14.4)	16.6 (8.1, 31.0)	29.9 (171, 46.7)	17.4 (8.1, 33.2)	13.3 (5.1, 30.3)	13.9 (5.5, 30.6)[a]
Secondary/vocational	8.4 (4.6, 15.0)	16.9 (12.0, 23.3)	27.1 (21.9, 33.0)	23.9 (18.1, 30.9)	9.4 (6.7, 13.1)	9.8 (6.9, 13.7)	4.5 (2.8, 7.2)
University	2.5 (0.3, 16.4)	11.0 (5.0, 22.4)	38.8 (25.7, 53.7)	20.1 (11.6, 32.4)	19.9 (11.6, 31.8)	6.1 (2.4, 14.5)	1.8 (0.6, 5.5)
All combined	6.7 (3.9, 11.0)	14.7 (10.9, 19.5)	28.7 (24.1, 33.8)	23.6 (18.6, 29.4)	12.4 (9.4, 16.1)	9.3 (6.8, 12.6)	4.7 (3.2, 6.8)

[a]P<0.05

More Māori, Pacifc and Asian people than European/other were represented in the younger age groups. More females than males were in the 18-24 group, but this was not statistically significant.

Table 66. Age by other sociodemographic characteristics for those who reported orofacial trauma (data are row percentage unless otherwise indicated; brackets contain 95% CI)

	Age group						
	18-24	25-34	35-44	45-54	55-64	65-74	75+
Sex							
Female	11.2 (7.1, 17.1)	18.1 (13.4, 24.1)	26.5 (21.7, 31.9)	20.7 (15.8, 26.6)	12.7 (9.5, 16.9)	8.7 (6.0, 12.3)	2.2 (1.1, 4.3)
Male	8.7 (5.5, 13.5)	16.2 (12.0, 21.4)	27.8 (22.8, 33.5)	22.7 (17.5, 28.9)	12.0 (9.1, 15.7)	7.7 (5.4, 10.9)	4.9 (3.3, 7.3)
Ethnic group							
Maori	14.4 (10.0, 20.2)	24.5 (19.2, 30.7)	28.1 (22.6, 34.5)	18.2 (14.3, 22.9)	10.2 (7.1, 14.4)	3.8 (2.3, 6.2)	0.8 (0.3, 2.1)[a]
Pacific	7.8 (2.0, 26.0)	33.0 (19.4, 50.1)	29.4 (18.4, 43.6)	25.2 (14.3, 40.6)	2.6 (0.6, 10.8)	0.8 (0.1, 7.2)	1.1 (0.2, 6.5)[a]
Asian	41.2 (24.1, 60.7)	25.7 (13.4, 43.6)	13.0 (7.5, 21.7)	11.1 (5.2, 22.1)	5.4 (2.4, 11.9)	1.7 (0.4, 5.9)	1.8 (0.3, 9.9)[a]
European/Other	7.7 (5.2, 11.4)	15.4 (11.8, 19.7)	28.2 (23.8, 32.9)	22.4 (18.2, 27.2)	13.2 (10.5, 16.5)	9.0 (7.0, 11.6)	4.2 (2.9, 5.9)[a]
Deprivation quintile							
1 (least deprived)	3.8 (1.0, 12.9)	14.5 (7.8, 25.3)	28.8 (19.3, 40.7)	29.8 (20.0, 41.9)	12.5 (7.4, 20.2)	6.6 (2.9, 14.4)	4.0 (1.6, 9.4)
2	15.9 (8.6, 27.8)	9.5 (4.7, 18.2)	22.7 (14.7, 33.5)	23.5 (15.0, 34.8)	15.1 (9.2, 23.9)	10.5 (6.3, 16.8)	2.7 (1.2, 6.3)
3	7.3 (2.8, 17.9)	18.1 (10.5, 29.2)	29.5 (21.0, 39.7)	20.6 (13.5, 30.1)	10.5 (6.1, 17.6)	10.5 (6.2, 17.3)	3.5 (1.5, 7.9)
4	7.6 (3.2, 17.1)	23.5 (14.7, 35.4)	34.4 (24.6, 45.7)	10.2 (5.9, 17.3)	13.5 (7.9, 22.2)	4.4 (2.2, 8.7)	6.3 (3.2, 12.1)
5 (most deprived)	12.5 (5.9, 24.6)	22.4 (14.6, 32.7)	22.1 (15.1, 31.2)	23.7 (15.4, 34.6)	8.4 (4.5, 15.2)	8.1 (4.5, 14.3)	2.8 (1.0, 7.4)
Highest education level							
Primary	2.9 (0.7, 11.7)	5.3 (2.1, 12.6)	27.4 (17.3, 40.4)	25.6 (15.4, 39.5)	17.1 (9.1, 29.7)	11.4 (5.0, 24.1)	10.3 (4.1, 23.6)[a]
Secondary/vocational	12.8 (8.9, 18.1)	18.3 (14.1, 23.4)	25.0 (20.6, 29.9)	21.8 (17.6, 26.8)	9.7 (7.2, 12.9)	8.6 (6.4, 11.5)	3.8 (2.5, 5.8)
University	2.1 (0.3, 11.8)	16.9 (10.2, 26.5)	34.8 (24.4, 46.8)	20.6 (13.5, 30.2)	18.9 (12.4, 27.8)	5.2 (2.4, 11.0)	1.6 (0.6, 4.1)
All combined	9.7 (6.9, 13.5)	17.0 (13.7, 20.8)	27.3 (23.6, 31.4)	21.9 (18.1, 26.2)	12.3 (9.8, 15.2)	8.1 (6.3, 10.4)	3.8 (2.7, 5.3)

[a]P<0.05

There were more Māori, Pacific and Asian people than European/other that had experienced orofacial trauma in the younger age groups.

Table 67. Sex by other sociodemographic characteristics for those who had clinical signs of dental trauma on teeth 13-23 (data are row percentage unless otherwise indicated; brackets contain 95% CI)

	Sex	
	Female	Male
Age group		
18-24	65.3 (39.9, 84.2)	34.7 (15.8, 60.1)
25-34	35.7 (22.1, 52.1)	64.3 (47.9, 77.9)
35-44	45.3 (35.5, 55.4)	54.7 (44.6, 64.5)
45-54	44.4 (33.4, 56.0)	55.6 (44.0, 66.6)
55-64	44.1 (28.9, 60.5)	55.9 (39.4, 71.1)
65-74	46.4 (27.0, 67.0)	53.6 (33.0, 73.0)
75+	11.2 (3.7, 29.3)	88.8 (70.7, 96.3)
Ethnic group		
Māori	51.3 (43.4, 59.1)	48.7 (40.9, 56.6)
Pacific	41.8 (26.1, 59.3)	58.2 (40.7, 73.9)
Asian	29.0 (16.3, 46.2)	71.0 (53.8, 83.7)
European/Other	45.1 (39.0, 51.3)	54.9 (48.7, 61.0)
Deprivation quintile		
1 (least deprived)	41.0 (29.5, 53.6)	59.0 (46.4, 70.5)
2	40.2 (26.9, 55.1)	59.8 (44.9, 73.1)
3	42.6 (29.1, 57.3)	57.4 (42.7, 70.9)
4	45.3 (30.8, 60.7)	54.7 (39.3, 69.2)
5 (most deprived)	52.2 (39.5, 64.6)	47.8 (35.4, 60.5)
Highest education level		
Primary	47.9 (31.6, 64.8)	52.1 (32.3, 68.4)
Secondary/vocational	43.4 (36.4, 50.5)	56.7 (49.5, 63.6)
University	45.1 (33.2, 57.5)	54.9 (42.5, 66.8)
All combined	44.2 (38.9, 49.6)	55.8 (50.4, 61.1)

[a]$P<0.05$

There were more males than females in the proportion who had clinical signs of dental trauma. There were more females than males in the 18-24 group, but this was not statistically significant. Slightly more Māori females than males were affected, but this was also not statistically significant.

Table 68. Age by other sociodemographic characteristics for those who had clinical signs of dental trauma on teeth 13-23 (data are row percentage unless otherwise indicated; brackets contain 95% CI)

	Age group						
	18-24	25-34	35-44	45-54	55-64	65-74	75+
Sex							
Female	14.1 (9.0, 21.5)	11.3 (7.2 (17.3)	32.6 (25.1, 41.1)	23.5 (17.0, 31.7)	11.1 (7.1, 17.1)	6.3 (3.5, 11.1)	1.0 (0.3, 3.1)
Male	5.9 (2.5, 13.2)	16.2 (10.3, 24.4)	31.2 (23.7, 39.9)	23.3 (16.2, 32.3)	11.2 (7.3, 16.7)	5.7 (3.3, 9.9)	6.5 (4.0, 10.5)
Ethnic group							
Maori	20.2 (6.3, 14.1)	28.5 (20.5, 38.1)	26.7 (19.6, 35.3)	16.4 (12.2, 21.7)	6.1 (3.7, 10.0)	1.9 (0.8, 4.8)	0.1 (0.0, 1.1)[a]
Pacific	27.8 (14.1, 47.4)	32.4 (17.8, 51.4)	22.7 (12.1, 38.7)	9.4 (3.8, 21.7)	4.7 (0.8, 23.7)	0.0 (—)	2.9 (0.5, 16.5)[a]
Asian	24.9 (9.3, 52.0)	27.5 (11.9, 51.6)	16.6 (8.6, 29.7)	19.2 (4.7, 23.0)	10.9 (4.7, 23.0)	0.9 (0.2, 3.8)	0.0 (—)[a]
European/Other	6.8 (3.9, 11.6)	11.0 (6.8, 17.1)	34.1 (27.2, 41.9)	24.5 (18.3, 31.9)	11.7 (8.5, 16.0)	7.1 (4.6, 10.7)	4.8 (3.0, 7.5)[a]
Deprivation quintile							
1 (least deprived)	4.7 (1.0, 20.1)	8.1 (2.7, 22.1)	33.7 (20.5, 50.0)	33.8 (21.0, 49.5)	11.7 (5.9, 21.8)	4.5 (1.6, 12.0)	3.5 (1.1, 11.1)
2	6.7 (1.9, 21.5)	8.3 (2.8, 22.3)	30.2 (18.1 (45.8)	23.1 (13.2, 37.4)	12.7 (6.6, 23.1)	11.4 (5.5, 22.1)	7.6 (3.4, 16.1)
3	10.9 (4.2, 25.5)	14.3 (5.7, 31.5)	28.9 (17.2, 44.3)	24.1 (14.2, 38.0)	9.0 (4.3, 17.6)	8.0 (3.3, 18.2)	4.9 (1.7, 13.4)
4	6.7 (1.6, 24.4)	19.8 (9.3, 37.5)	43.2 (29.1, 58.2)	12.0 (6.5, 21.1)	14.2 (6.9, 27.2)	1.8 (0.4, 8.6)	2.1 (0.5, 8.8)
5 (most deprived)	19.2 (10.5, 35.2)	21.0 (12.8, 32.6)	23.8 (14.9, 35.7)	21.6 (11.6, 36.7)	8.3 (3.4, 18.6)	3.9 (1.3, 11.3)	2.2 (0.8 6.3)
Highest education level							
Primary	2.9 (0.3, 22.2)	9.7 (4.7, 19.0)	22.9 (12.2, 38.7)	29.2 (14.7, 49.6)	14.4 (6.9, 27.6)	7.0 (1.9, 22.6)	13.9 (5.5, 31.1)[a]
Secondary/vocational	12.6 (7.9, 19.6)	13.9 (9.5, 20.0)	29.8 (23.4, 37.1)	23.8 (17.6, 31.4)	9.3 (6.0, 14.1)	6.5 (3.9, 10.6)	4.0 (0.1, 4.2)
University	3.3 (0.6, 16.1)	15.9 (8.0, 29.2)	40.7 (27.5, 55.5)	20.3 (11.4, 33.3)	15.0 (8.4, 25.3)	4.1 (1.7, 9.2)	0.7 (0.1, 4.2)
All combined	9.5 (6.3, 14.1)	14.0 (9.9, 19.5)	31.8 (25.9, 38.3)	23.4 (18.1, 29.7)	11.1 (8.3, 14.9)	6.0 (3.9, 9.0)	4.1 (2.6, 6.3)

[a]P<0.05

There were more people in the 35-44 age group. More females than males were in the 18-24 and 65-74 groups, but this was not statistically significant. More Māori, Pacific and Asian people than European/other were represented in the younger age groups.